Nokia Customer Care

# *Service Manual*

## RM-100 (Nokia N92)

# Mobile Terminal

***Part No: 9252561 (Issue 2)***

***COMPANY CONFIDENTIAL***

NOKIA

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## Amendment Record Sheet

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## IMPORTANT

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# Warnings and cautions

## Warnings

- IF THE DEVICE CAN BE INSTALLED IN A VEHICLE, CARE MUST BE TAKEN ON INSTALLATION IN VEHICLES FITTED WITH ELECTRONIC ENGINE MANAGEMENT SYSTEMS AND ANTI-SKID BRAKING SYSTEMS. UNDER CERTAIN FAULT CONDITIONS, EMITTED RF ENERGY CAN AFFECT THEIR OPERATION. IF NECESSARY, CONSULT THE VEHICLE DEALER/ MANUFACTURER TO DETERMINE THE IMMUNITY OF VEHICLE ELECTRONIC SYSTEMS TO RF ENERGY.
- THE PRODUCT MUST NOT BE OPERATED IN AREAS LIKELY TO CONTAIN POTENTIALLY EXPLOSIVE ATMOSPHERES, FOR EXAMPLE, PETROL STATIONS (SERVICE STATIONS), BLASTING AREAS ETC.
- OPERATION OF ANY RADIO TRANSMITTING EQUIPMENT, INCLUDING CELLULAR TELEPHONES, MAY INTERFERE WITH THE FUNCTIONALITY OF INADEQUATELY PROTECTED MEDICAL DEVICES. CONSULT A PHYSICIAN OR THE MANUFACTURER OF THE MEDICAL DEVICE IF YOU HAVE ANY QUESTIONS. OTHER ELECTRONIC EQUIPMENT MAY ALSO BE SUBJECT TO INTERFERENCE.
- BEFORE MAKING ANY TEST CONNECTIONS, MAKE SURE YOU HAVE SWITCHED OFF ALL EQUIPMENT.

## Cautions

- Servicing and alignment must be undertaken by qualified personnel only.
- Ensure all work is carried out at an anti-static workstation and that an anti-static wrist strap is worn.
- Ensure solder, wire, or foreign matter does not enter the telephone as damage may result.
- Use only approved components as specified in the parts list.
- Ensure all components, modules, screws and insulators are correctly re-fitted after servicing and alignment.
- Ensure all cables and wires are repositioned correctly.
- Never test a mobile phone WCDMA transmitter with full Tx power, if there is no possibility to perform the measurements in a good performance RF-shielded room. Even low power WCDMA transmitters may disturb nearby WCDMA networks and cause problems to 3G cellular phone communication in a wide area.
- During testing never activate the GSM or WCDMA transmitter without a proper antenna load, otherwise GSM or WCDMA PA may be damaged.


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## ESD protection

Nokia requires that service points have sufficient ESD protection (against static electricity) when servicing the phone.

Any product of which the covers are removed must be handled with ESD protection. The SIM card can be replaced without ESD protection if the product is otherwise ready for use.

To replace the covers ESD protection must be applied.

All electronic parts of the product are susceptible to ESD. Resistors, too, can be damaged by static electricity discharge.

All ESD sensitive parts must be packed in metallized protective bags during shipping and handling outside any ESD Protected Area (EPA).

Every repair action involving opening the product or handling the product components must be done under ESD protection.

ESD protected spare part packages MUST NOT be opened/closed out of an ESD Protected Area.

For more information and local requirements about ESD protection and ESD Protected Area, contact your local Nokia After Market Services representative.


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## Care and maintenance

This product is of superior design and craftsmanship and should be treated with care. The suggestions below will help you to fulfil any warranty obligations and to enjoy this product for many years.

- Keep the phone and all its parts and accessories out of the reach of small children.
- Keep the phone dry. Precipitation, humidity and all types of liquids or moisture can contain minerals that will corrode electronic circuits.
- Do not use or store the phone in dusty, dirty areas. Its moving parts can be damaged.
- Do not store the phone in hot areas. High temperatures can shorten the life of electronic devices, damage batteries, and warp or melt certain plastics.
- Do not store the phone in cold areas. When it warms up (to its normal temperature), moisture can form inside, which may damage electronic circuit boards.
- Do not drop, knock or shake the phone. Rough handling can break internal circuit boards.
- Do not use harsh chemicals, cleaning solvents, or strong detergents to clean the phone.
- Do not paint the phone. Paint can clog the moving parts and prevent proper operation.
- Use only the supplied or an approved replacement antenna. Unauthorised antennas, modifications or attachments could damage the phone and may violate regulations governing radio devices.

All of the above suggestions apply equally to the product, battery, charger or any accessory.


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Our policy is of continuous development; details of all technical modifications will be included with service bulletins.

While every endeavour has been made to ensure the accuracy of this document, some errors may exist. If any errors are found by the reader, NOKIA MOBILE PHONES Business Group should be notified in writing/e-mail.

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- Title of the Document + Issue Number/Date of publication
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## Battery information

**Note:** A new battery's full performance is achieved only after two or three complete charge and discharge cycles!

The battery can be charged and discharged hundreds of times but it will eventually wear out. When the operating time (talk-time and standby time) is noticeably shorter than normal, it is time to buy a new battery.

Use only batteries approved by the phone manufacturer and recharge the battery only with the chargers approved by the manufacturer. Unplug the charger when not in use. Do not leave the battery connected to a charger for longer than a week, since overcharging may shorten its lifetime. If left unused a fully charged battery will discharge itself over time.

Temperature extremes can affect the ability of your battery to charge.

For good operation times with Ni-Cd/NiMh batteries, discharge the battery from time to time by leaving the product switched on until it turns itself off (or by using the battery discharge facility of any approved accessory available for the product). Do not attempt to discharge the battery by any other means.

Use the battery only for its intended purpose.

Never use any charger or battery which is damaged.

Do not short-circuit the battery. Accidental short-circuiting can occur when a metallic object (coin, clip or pen) causes direct connection of the + and - terminals of the battery (metal strips on the battery) for example when you carry a spare battery in your pocket or purse. Short-circuiting the terminals may damage the battery or the connecting object.

Leaving the battery in hot or cold places, such as in a closed car in summer or winter conditions, will reduce the capacity and lifetime of the battery. Always try to keep the battery between 15°C and 25°C (59°F and 77°F). A phone with a hot or cold battery may temporarily not work, even when the battery is fully charged. Batteries' performance is particularly limited in temperatures well below freezing.

Do not dispose of batteries in a fire!

Dispose of batteries according to local regulations (e.g. recycling). Do not dispose as household waste.


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## Nokia N92 Service Manual Structure

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4 Service Tools and Service Concepts
5 Disassembly/Reassembly Instructions
6 BB Troubleshooting and Manual Tuning Guide
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Glossary


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# 1 — General Information

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## RM-100 product selection

Nokia RM-100 is a WCDMA/GSM dual mode handportable phone that supports GSM (E-GSM900, GSM1800 & GSM900) and WCDMA2100.

According to GSM standard 05.05 it responds to class 4 (max. 2W) in EGSM 900, class 1 (1W) in GSM 1800 and class 1 in GSM 1900. RM-100 supports EGPRS (EDGE) class B as well as Bluetooth specification 1.2/2.0/2.0+EDR. The handset has a full phase 2 Type Approval and it complies with the GSM Type Approval. RM-100 also has a full CE approval and FCC approval.

RM-100 supports two-way video calls with two integrated cameras. It is an MMS (Multimedia Messaging Service) enabled phone with a large bright color display and an integrated 2.0 megapixel (effective image size 1.92 megapixels) digital camera, and a second CIF digital camera.

The MMS implementation follows the OMA MMS standard release 1.2.

WAP 2.0 compatible browser supports XHTML Mobile Profile (MP) and uses a TCP/IP stack to communicate with a gateway in network.

RM-100 uses Symbian OS 9.1 operating system and supports also MIDP Java 2.0 & CLDC1.1, providing a good platform for 3rd party applications.

**Figure 1 View of RM-100**

## RM-100 product features and sales package

### Display and keypad features

- Active matrix colour 2.8" QVGA main display (320x240, up to 16M colours) and 2nd display 1,1" (128x36 pixel, up to 65,536 colours)
- 4 media keys: play/pause, stop, next and previous.
- 5-way navikey, two softkeys, application-key, clear key, send & end key, ~(operator) service key and multimedia key.
- ITU-T keypad.
- Side volume keys (volume control and mute).

### Key features

- Stylish twist ~& fold phone with metal decos


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- WCDMW/GSM dual mode handportable device supporting EGSM900/1800/1900 and WCDMA 2100 with internal antennas
- WCDMA 2100 with simultaneous voice and packet data (PS max speed UL/DL= 384/384kbps, CS max speed 64kpbs)
- Dual Transfer Mode (DTM) class 11 in GSM networks to support simultaneous voice and packet data
- Integrated DVB-H video/audio codecs: H.264 AVC 384kbps at QVGA 15fps/QCIF 30fps and AAC up to 128bps
- EGPRS, class B, multislot class 32, (5 Rx + 3 Tx/max sum 6), max speed DL/UL = 296/177.6 kbits/s
- GPRS, class B, multislot class 32 is also supported with (5 Rx + 3 Tx/max sum 6), max speed DL/UL = 107/64.2 kbits/s
- Speech codecs: FR, EFR, WCDMA and GSM AMR
- Audio codecs: AAC, AAC+, AMR, AMR-NB, AMR-WB, AU, eAAC+, MIDI, MP3, Nokia ring tones, Real Audio 7/8/10, WAV and WMA
- Integrated 2.0 megapixel (1600 x 1200) camera with up to 4x digital zoom for video/still pictures
- Integrated Flash LED (operating range 1,5 m)
- Privacy indicator LED
- Integrated CIF camera with 2 x digital zoom
- Up to 40 MB internal memory for user data and mini SD card reader (hotswap)
- Bluetooth connectivity, IrDA, and USB 2.0 full speed
- Integrated WLAN (802.11b/g) & UPnP
- Integrated stereo handsfree speaker
- XHTML internet browser-open source
- Integrated FM Stereo radio
- Off-line mode/SIMless mode
- Java™ MIDP 2.0, CLDC 1.1
- Real time clock

## Imaging

- Two-way video call
- Advanced camera modes: still/burst/video, night, image quality, self timer, white balance settings and colour tones
- Flash LED modes: On, Off, Automatic
- Bluetooth Imaging Profile (BIP) and Pictbridge
- Improved multimedia gallery
- Still image editor, image printing, Nokia Lifeblog and image show

## Productivity

- SMS, MMS and email
- Office document viewers (Word, Powerpoint, Excel)
- PC Suite connectivity with USB, Bluetooth, IrDA
- Advanced S60 PIM (calendar, contacts, task list, etc.)
- Multimedia player (Real Player) with 3GPP video streaming support
- Voice recording, dialling and voice commands


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- Access point configurator and settings Wizard 2.0
- Start up wizard for easy configuration
- Data Transfer (from S60 phone to S60 phone)

### Mobile TV features

- Dedicated mobile TV application for selection, purchase, consumption and storage of TV programs
- Record & Playback and Replay of TV programs
- Mobile TV interactive services
- DVB-H based mobile TV with internal antenna
- Mobile TV video/audio codecs: H264 ACV/AAC
- Channel and content protection: OMA DRM 2.0, IPsec

### Sales package

- Transceiver RM-100
- BP-5L Li-Polymer Battery Cell
- AC-4 Charger
- All-in-one User Guide (warranty card + accessory info + getting started sheet + invitational module for Club Nokia )
- CD-ROM (with PC-Suite)
- Stereo Headset HS-23
- USB Cable CA-53
- Mini SD and miniSD adapter

## Product and module list

| Module name | Type code | Notes |
|---|---|---|
| System/RF Module | RM100: 1NT | Main PWB with components, keyboard |
| Top module | RM100: 1PH | DVB-H engine, mini SD reader |
| Bottom module flex | 1QX | Flash LED & volume keys |
| Top module flex | 1QY | Power switch & earpiece |

## Mobile enhancements

**Table 1 Audio**

| Enhancement | Type |
|---|---|
| Fashion stereo headset | HS-3, HS-31 |
| Classic stereo headset | HS-23 |
| Stereo headset | HS-20 + AD-41 |
| Activity headset | HS-8 |
| Wireless clip-on headset | HS-21W |
| Wireless boom headset | HS-4W |


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| Enhancement | Type |
|---|---|
| Inductive loopset | LPS-4 |
| Wireless headsets | HDW-3, HS-11W, HS-26W, HS-36W, & HS-37W |
| Bluetooth headset BH-200 | HS-58W |
| Bluetooth headset BH-800 | HS-24W |
| Bluetooth headset BH-900 | HS-25W |
| Audio adapter | AD-15, AD-46 |
| Music stand | MD-1 |

**Table 2 Car**

| Enhancement | Type |
|---|---|
| Mobile charger | DC-4 |
| Plug-in car handsfree | HF-3 |
| Advanced car kits | CK-7W |
| Wireless car kit | CK-1W |
| Plug-in wireless car handsfree | HF-6W |
| Car kit phone | N616 |

**Table 3 Covers**

| Enhancement | Type |
|---|---|
| Non-changeable covers | |

**Table 4 Data**

| Enhancement | Type |
|---|---|
| Connectivity cable | CA-53 |
| Wireless GPS module | LD-1W, LD-3W |
| MiniSD memory card 128MB | MU-17 |
| MiniSD memory card 256MB | MU-18 |
| MiniSD memory card 512MB | MU-23 |
| MiniSD memory card 1GB | MU-24 |

**Table 5 Messaging**

| Enhancement | Type |
|---|---|
| Digital pen | SU-1B |


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| Enhancement | Type |
|---|---|
| Wireless keyboard | SU-8W |

**Table 6 Power**

| Enhancement | Type |
|---|---|
| Battery 1500mAh | BP-5L |
| Compact charger | AC-3 |
| Travel charger | AC-4, AC-5 |
| Charger adapter | CA-44 |

## Technical specifications

### Transceiver general specifications

| Unit | Dimensions (L x W x T) (mm) | Weight (g) | Volume (cm3) |
|---|---|---|---|
| Transceiver with BP-5L 1500mAh battery | 107.4 x 58.2 x 24.8 mm | ~191g | <136cc |

### Main RF characteristics for triple-band (EGSM900/GSM1800/GSM1900) and WCDMA phones

| Parameter | Unit |
|---|---|
| Cellular system | EGSM900, GSM1800/1900 and WCDMA |
| Rx frequency band | EGSM900: 925 - 960 MHz |
| | GSM1800: 1805 - 1880 MHz |
| | GSM1900: 1930 - 1990 MHz |
| | WCDMA: 2110 - 2170 MHz |
| Tx frequency band | EGSM900: 880 - 915 MHz |
| | GSM1800: 1710 - 1785 MHz |
| | GSM1900: 1850 - 1910 MHz |
| | WCDMA: 1920 - 1980 MHz |
| Output power | GSM900: +5 ... +33dBm/3.2mW ... 2W |
| | GSM1800: +0 ... +30dBm/1.0mW ... 1W |
| | GSM1900: +0 ... +30dBm/1.0mW ... 1W |
| | WCDMA -50 ... 24 dBm |
| Number of RF channels | GSM900: 125 |
| | GSM1800: 375 |
| | GSM1900: 300 |
| | WCDMA: 277 |


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| Parameter | Unit |
|---|---|
| Channel spacing | 200 kHz |
| Number of Tx power levels | GSM900: 15 |
| | GSM1800: 16 |
| | GSM1900: 16 |

## Battery endurance

| Battery | Capacity (mAh) | Talk time | Stand-by |
|---|---|---|---|
| BP-5L | 1500 | Up to 6 hrs(GSM)<br>Up to 4 hrs 18 min (WCDMA) | Up to 233 hours |

## Charging times

| AC-3 | AC-4 |
|---|---|
| approx. 180min | approx. 120 min |

## Environmental conditions

| Environmental condition | Ambient temperature | Notes |
|---|---|---|
| Normal operation | -15ºC...+55ºC | Specifications fulfilled |
| Reduced performance | -25ºC...-15ºC<br>+55ºC...+70ºC | Operational for shorts periods only |
| Intermittent operation | -40ºC...-15ºC<br>+70ºC...+85 ºC | Operation not guaranteed but an attempt to operate does not damage the phone. |
| No operation or storage | <-40ºC...>+85ºC | No storage or operation: an attempt may damage the phone. |
| Charging allowed | -25ºC...+50ºC | |
| Long term storage conditions | 0ºC...+85ºC | |


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# 2 — Parts Lists and Component Layouts


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## Exploded view

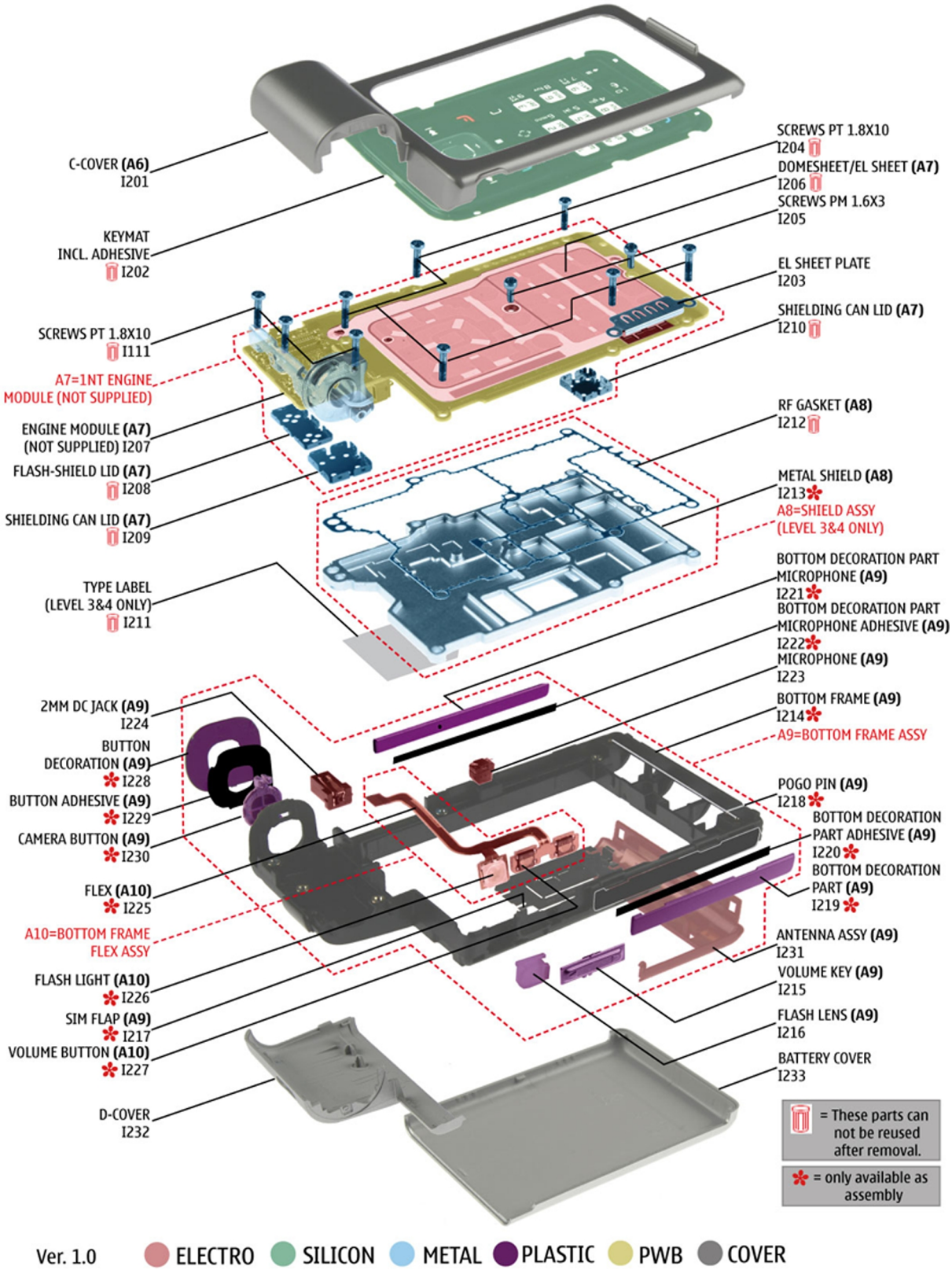


**Figure 2 Bottom module exploded view**


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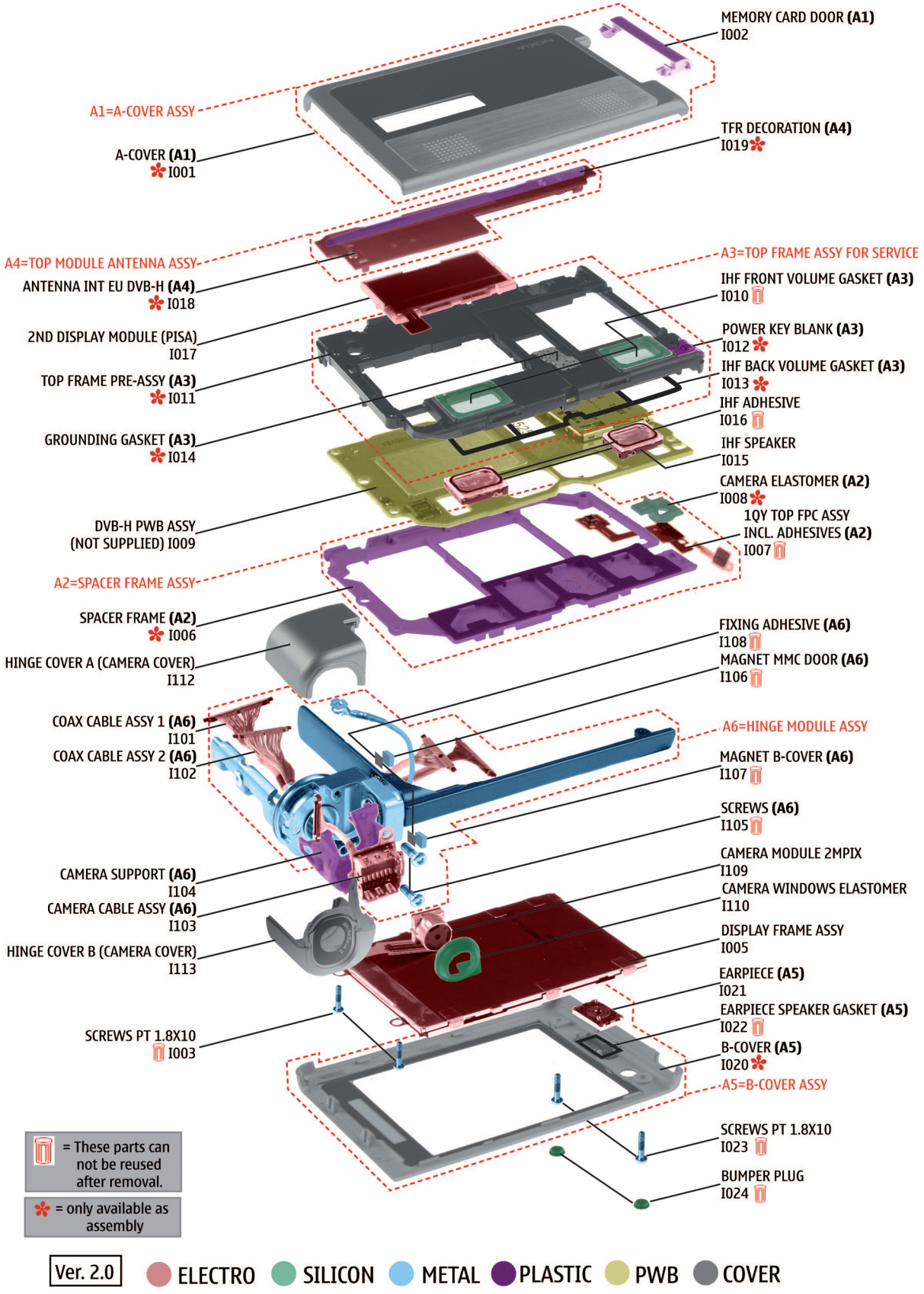


**Figure 3 Top module and hinge exploded view**


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## Mechanical spare parts list

**Note:** For Nokia product codes, please refer to the latest Service Bulletins on the Partner Website (PWS).
To ensure you are always using the latest codes, please check the PWS on a daily basis.

Ax and in bold = ASSY
"-" = NOT AVAILABLE
"XXXXXXX" = VARIANTS
"???????" = Code available in Bulletin
I0xx = ITEM codes for upper or mono block
I1xx = ITEM codes for hinge block
I2xx = ITEM codes for lower block
I3xx = ITEM codes for soldered spare parts on the upper, hinge or lower block and not exchangable

| ITEM/CIRCUIT REF. | QTY | PART NO | PART NAME | NOTE |
|---|---|---|---|---|
| A1 | 1 | XXXXXXX | A-COVER ASSY (I001 - I002) | |
| I001 | 1 | - | A-COVER | |
| I002 | 1 | XXXXXXX | MEMORY CARD DOOR | |
| I003 | 2 | ??????? | SCREWS PT1.8x10 | Cannot be reused after removal |
| I005 | 1 | ??????? | DISPLAY FRAME ASSY | |
| A2 | 1 | ??????? | SPACER FRAME ASSY (I006 - I008) | |
| I006 | 1 | - | SPACER FRAME | |
| I007 | 1 | ??????? | 1QY TOP FPC ASSY incl. ADHESIVES | Cannot be reused after removal |
| I008 | 1 | - | CAMERA ELASTOMER | |
| I009 | 1 | ??????? | DVB-H PWB ASSY | |
| A3 | 1 | XXXXXXX | TOP FRAME ASSY FOR SERVICE(I010-I014) | |
| I010 | 2 | ??????? | IHF FRONT VOLUME GASKET | Cannot be reused after removal |
| I011 | 1 | - | TOP FRAME PRE-ASSY | |
| I012 | 1 | - | POWER KEY BLANK | |
| I013 | 1 | - | IHF BACK VOLUME GASKET | |


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| ITEM/CIRCUIT REF. | QTY | PART NO | PART NAME | NOTE |
|---|---|---|---|---|
| I014 | 1 | - | GROUNDING GASKET | |
| I015 | 2 | ??????? | IHF SPEAKER | |
| I016 | 2 | ??????? | IHF ADHESIVE | Cannot be reused after removal |
| I017 | 1 | ??????? | 2nd DISPLAY MODULE (PISA) | |
| A4 | 1 | XXXXXXX | TOP MODULE ANTENNA ASSY (I017 - I018) | |
| I018 | 1 | - | ANTENNA INT EU DVB-H | |
| I019 | 1 | - | TFR DECORATION | |
| A5 | 1 | XXXXXXX | B-COVER ASSY (I020 - I022) | |
| I020 | 1 | - | B-COVER | |
| I021 | 1 | ??????? | EARPIECE | |
| I022 | 1 | ??????? | EARPIECE SPEAKER GASKET | Cannot be reused after removal |
| I023 | 2 | ??????? | SCREWS PT1.8x10 | Cannot be reused after removal |
| I024 | 2 | ??????? | BUMPER PLUG | Cannot be reused after removal |
| A6 | 1 | XXXXXXX | HINGE MODULE ASSY (I101 - I107) | |
| I101 | 1 | ??????? | COAX CABLE ASSY 1 | |
| I102 | 1 | ??????? | COAX CABLE ASSY 2 | |
| I103 | 1 | ??????? | CAMERA CABLE ASSY | |
| I104 | 1 | ??????? | CAMERA SUPPORT | |
| I105 | 2 | ??????? | SCREWS | Cannot be reused after removal |
| I106 | 1 | ??????? | MAGNET MMC DOOR | Cannot be reused after removal |
| I107 | 1 | ??????? | MAGNET B-COVER | Cannot be reused after removal |
| I108 | 2 | ??????? | FIXING ADHESIVE | Cannot be reused after removal |


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| ITEM/CIRCUIT REF. | QTY | PART NO | PART NAME | NOTE |
|---|---|---|---|---|
| I109 | 1 | ??????? | CAMERA MODULE 2Mpix | |
| I110 | 1 | ??????? | CAMERA WINDOW ELASTOMER | |
| I111 | 3 | ??????? | SCREWS PT1.8x10 | Cannot be reused after removal |
| I112 | 1 | XXXXXXX | HINGE COVER A (CAMERA COVER) | |
| I113 | 1 | XXXXXXX | HINGE COVER B (CAMERA COVER) | |
| I201 | 1 | XXXXXXX | C-COVER | |
| I202 | 1 | XXXXXXX | KEYMAT incl. ADHESIVE | Cannot be reused after removal |
| I203 | 1 | ??????? | EL-SHEET PLATE | |
| I204 | 6 | ??????? | SCREWS PT1.8x10 | Cannot be reused after removal |
| I205 | 2 | ??????? | SCREWS PM1.6x3 | |
| | | | | |
| A7 | 1 | - | 1NT ENGINE MODULE ASSY(I206 - I210) | |
| I206 | 1 | ??????? | DOMESHEET / EL SHEET | Cannot be reused after removal |
| I207 | 1 | - | ENGINE MODULE | |
| I208 | 1 | ??????? | FLASH-SHIELD LID | Cannot be reused after removal |
| I209 | 1 | ??????? | SHIELDING CAN LID | Cannot be reused after removal |
| I210 | 1 | ??????? | SHIELDING CAN LID | Cannot be reused after removal |
| | | | | |
| I211 | 1 | ??????? | TYPE LABEL | Cannot be reused after removal |
| | | | | |
| A8 | 1 | ??????? | SHIELD ASSY(I212 - I213) | |
| I212 | 1 | ??????? | RF GASKET | Cannot be reused after removal |
| I213 | 1 | - | METAL SHIELD | |
| | | | | |
| A9 | 1 | XXXXXXX | BOTTOM FRAME ASSY(I214 - I231) | |
| I214 | 1 | - | BOTTOM FRAME | |


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| ITEM/CIRCUIT REF. | QTY | PART NO | PART NAME | NOTE |
|---|---|---|---|---|
| I215 | 1 | XXXXXXX | VOLUME KEY | |
| I216 | 1 | ??????? | FLASH LENS | |
| I217 | 1 | - | SIM FLAP | |
| I218 | 4 | - | POGO PIN | |
| I219 | 1 | - | BOTTOM DECORATION PART | |
| I220 | 1 | - | BOTTOM DECORATION PART ADHESIVE | |
| I221 | 1 | - | BOTTOM DECORATION PART MICROPHONE | |
| I222 | 1 | - | BOTTOM DECORATION PART MICROPHONE ADHESIVE | |
| I223 | 1 | ??????? | MICROPHONE | |
| I224 | 1 | ??????? | 2 mm DC JACK | |
| A10 | 1 | ??????? | BOTTOM FRAME FLEX ASSY(I225 - I227) | |
| I225 | 1 | - | FLEX | |
| I226 | 1 | - | FLASH LIGHT | |
| I227 | 2 | - | VOLUME BUTTON | |
| I228 | 1 | - | BUTTON DECORATION | |
| I229 | 1 | - | BUTTON ADHESIVE | |
| I230 | 1 | - | CAMERA BUTTON | |
| I231 | 1 | XXXXXXX | ANTENNA ASSY | |
| | | | | |
| I232 | 1 | XXXXXXX | D-COVER | |
| I233 | 1 | XXXXXXX | BATTERY COVER | |

## Component parts lists and layouts 1NT_15a

### Component parts list 1NT_14a

| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| A1001 | Top | F | 3 | SHIELD_040_018734 | SHIELDING CAN ASSEMBLY 1.9X7.9X8.85 | ~ | ~ |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| A4400 | Top | S | 9 | SHIELD_040_013073 | FLASH-SHIELD ASSEMBLY | ~ | ~ |
| A5200 | Top | S | 7 | SHIELD_040_018734 | SHIELDING CAN ASSEMBLY 1.9X7.9X8.85 | ~ | ~ |
| B2200 | Top | J | 10 | CRYSTAL_3.3X1.6_H0.9 | CRYSTAL 32.768KHZ +-30PPM 12.5PF | 32.768kHz | ~ |
| C2000 | Top | R | 10 | 0402C | Chipcap 5% NP0 | 27p | 50V |
| C2002 | Top | M | 10 | 0402C | Chipcap 5% NP0 | 10p | 50V |
| C2003 | Top | M | 10 | 0402C | Chipcap 5% NP0 | 10p | 50V |
| C2005 | Top | N | 9 | 0402C | chipcap x7r 47n k 10v 0402 | 47n | 10V |
| C2006 | Top | N | 9 | 0402C | chipcap x7r 47n k 10v 0402 | 47n | 10V |
| C2009 | Top | M | 10 | 0402C | Chipcap 5% NP0 | 10p | 50V |
| C2010 | Top | M | 10 | 0402C | Chipcap 5% NP0 | 10p | 50V |
| C2012 | Bottom | R | 10 | 0603C | CHIPCAP X5R 220N K 25V 0603 | 220n | 25V |
| C2013 | Bottom | R | 10 | 0603C | CHIPCAP X5R 220N K 25V 0603 | 220n | 25V |
| C2070 | Top | R | 9 | TANT_C_6.2X3.4_H1.7 | CHIPTCAP 150U M 10V 6X3.2X1.5 | 150u_10V | 10V |
| C2071 | Top | Q | 7 | 0402C | Chipcap 5% NP0 | 15p | 50V |
| C2100 | Top | J | 10 | 0402C | Chipcap X7R 10% 16V 0402 | 10n | 16V |
| C2120 | Top | K | 9 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2121 | Top | K | 9 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2123 | Top | L | 8 | 0402C | CHIPCAP X5R 1U K 6V3 0402 | 1u0 | 6.3V |
| C2124 | Top | K | 9 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2125 | Top | K | 9 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2127 | Top | J | 10 | 0402C | Chipcap X7R 10% 50V 0402 | 1n0 | 50V |
| C2128 | Top | J | 10 | 0402C | Chipcap X7R 10% 50V 0402 | 1n0 | 50V |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| C2129 | Top | J | 10 | 0402C | Chipcap X7R 10% 50V 0402 | 1n0 | 50V |
| C2130 | Top | K | 10 | 0402C | Chipcap X7R 10% 50V 0402 | 1n0 | 50V |
| C2131 | Top | K | 10 | 0402C | Chipcap X7R 10% 50V 0402 | 1n0 | 50V |
| C2132 | Top | K | 10 | 0402C | Chipcap X7R 10% 50V 0402 | 1n0 | 50V |
| C2133 | Top | L | 10 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2134 | Top | L | 9 | 0805C | CHIPCAP X5R 10U M 6V3 0805 | 10U | 6V3 |
| C2135 | Top | L | 9 | 0402C | CHIPCAP X5R 1U K 6V3 0402 | 1u0 | 6.3V |
| C2200 | Top | K | 9 | 0603C | CHIPCAP X5R 2U2 K 6V3 0603 | 2u2 | 6V3 |
| C2201 | Top | I | 9 | 0402C | CHIPCAP X5R 1U5 K 4V 0402 | 1u5 | 4V |
| C2202 | Top | K | 9 | 0603C | CHIPCAP X5R 2U2 K 6V3 0603 | 2u2 | 6V3 |
| C2205 | Top | K | 9 | 0402C | Chipcap X7R 10% 50V 0402 | 1n0 | 50V |
| C2211 | Top | I | 8 | 0805C | CHIPCAP X5R 4U7 K 10V 0805 | 4u7 | 10V |
| C2213 | Top | I | 9 | 0405_DUAL | CHIPCAP NETWORK X5R 2X1U5 K 6V3 0405 | 2x1u5 | 6.3V |
| C2215 | Top | I | 9 | 0405_DUAL | CHIPCAP NETWORK X5R 2X1U5 K 6V3 0405 | 2x1u5 | 6.3V |
| C2216 | Top | I | 10 | 0402C | CHIPCAP X5R 1U5 K 4V 0402 | 1u5 | 4V |
| C2217 | Top | K | 9 | 0402C | CHIPCAP X5R 1U5 K 4V 0402 | 1u5 | 4V |
| C2220 | Top | J | 8 | 0405_DUAL | CHIPCAP NETWORK X5R 2X1U5 K 6V3 0405 | 2x1u5 | 6.3V |
| C2222 | Top | I | 8 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |
| C2225 | Top | J | 8 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| C2226 | Top | I | 9 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |
| C2227 | Top | I | 9 | 0405_DUAL | CHIPCAP NETWORK X5R 2X1U5 K 6V3 0405 | 2x1u5 | 6.3V |
| C2228 | Top | I | 8 | 0405_DUAL | CHIPCAP NETWORK X5R 2X1U5 K 6V3 0405 | 2x1u5 | 6.3V |
| C2231 | Top | K | 8 | 0805C | CHIPCAP X5R 10U M 6V3 0805 | 10U | 6V3 |
| C2232 | Top | I | 8 | 0405_DUAL | CHIPCAP NETWORK X5R 2X1U5 K 6V3 0405 | 2x1u5 | 6.3V |
| C2300 | Top | N | 9 | 0402C | Chipcap X7R 10% 16V 0402 | 10n | 16V |
| C2301 | Top | N | 9 | 0805C | CHIPCAP X5R 22U M 6V3 0805 | 22u | 6V3 |
| C2302 | Top | L | 9 | 0805C | CHIPCAP X5R 22U M 6V3 0805 | 22u | 6V3 |
| C2303 | Top | N | 7 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |
| C2304 | Top | N | 8 | 0402C | Chipcap X7R 10% 16V 0402 | 10n | 16V |
| C2307 | Top | N | 7 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |
| C2308 | Top | P | 8 | 0402C | CHIPCAP X5R 1U K 6V3 0402 | 1u0 | 6.3V |
| C2309 | Top | O | 9 | 0805C | CHIPCAP X5R 22U M 6V3 0805 | 22u | 6V3 |
| C2312 | Top | O | 8 | 0405_DUAL | CHIPCAP NETWORK X5R 2X1U5 K 6V3 0405 | 2x1u5 | 6.3V |
| C2314 | Top | O | 8 | 0805C | CHIPCAP X5R 4U7 M 25V 0805 | 4u7 | 25V |
| C2700 | Top | H | 2 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2800 | Top | L | 6 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2801 | Top | J | 6 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2802 | Top | L | 6 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| C2803 | Top | L | 4 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2804 | Top | J | 4 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2805 | Top | K | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2806 | Top | K | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2807 | Top | J | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2808 | Top | J | 6 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2809 | Top | L | 6 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2810 | Top | K | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2811 | Top | J | 4 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2812 | Top | L | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2813 | Top | L | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2814 | Top | L | 5 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2815 | Top | K | 4 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2816 | Top | L | 5 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2817 | Top | J | 4 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2818 | Top | L | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2819 | Top | K | 4 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2820 | Top | J | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2821 | Top | L | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C2822 | Top | K | 4 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C3100 | Top | I | 7 | 0402C | Chipcap 5% NP0 | 27p | 50V |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| C4200 | Top | L | 7 | 0805C | CHIPCAP X5R 22U M 6V3 0805 | 22u | 6V3 |
| C4201 | Top | M | 7 | 0805C | CHIPCAP X5R 22U M 6V3 0805 | 22u | 6V3 |
| C4202 | Top | N | 7 | 0402C | Chipcap X7R 10% 16V 0402 | 10n | 16V |
| C4224 | Bottom | T | 5 | 0603C_H0.95 | CHIPCAP X5R 1U K 25V 0603 | 1u0 | 25V |
| C4226 | Bottom | T | 6 | 0603C_H0.95 | CHIPCAP X5R 1U K 25V 0603 | 1u0 | 25V |
| C4401 | Bottom | S | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4402 | Bottom | S | 7 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4403 | Top | O | 9 | 0402C | Chipcap 5% NP0 | 10p | 50V |
| C4404 | Bottom | S | 7 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4405 | Top | O | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4406 | Bottom | S | 6 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4407 | Bottom | R | 6 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4408 | Bottom | R | 8 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4409 | Bottom | S | 8 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4410 | Bottom | S | 8 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4411 | Top | S | 10 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4412 | Top | S | 10 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4413 | Top | R | 10 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4414 | Top | T | 10 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4415 | Top | T | 10 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4416 | Top | T | 10 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4417 | Top | S | 10 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4418 | Top | S | 10 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4419 | Top | S | 10 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4420 | Top | T | 6 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| C4421 | Top | T | 5 | 0603C | CHIPCAP X5R 4U7 K 6V3 0603 | 4u7 | 6.3V |
| C4422 | Top | T | 6 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4423 | Top | S | 10 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4424 | Top | R | 10 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4425 | Top | S | 10 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4426 | Bottom | R | 8 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4427 | Bottom | R | 8 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4428 | Bottom | R | 8 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4429 | Bottom | R | 8 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4430 | Top | G | 4 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4431 | Top | H | 4 | 0402C | Chipcap X7R 10% 25V 0402 | 6n8 | 25V |
| C4433 | Top | G | 5 | 0402C | CHIPCAP X5R 1U K 6V3 0402 | 1u0 | 6.3V |
| C4435 | Top | H | 4 | 0603C | Cer cap 5% X7R | 10n | 50V |
| C4437 | Top | H | 5 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |
| C4438 | Top | P | 5 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4439 | Top | R | 7 | 0402C | Chipcap X7R 10% 16V 0402 | 10n | 16V |
| C4440 | Bottom | S | 8 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4441 | Bottom | S | 8 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4442 | Top | R | 9 | 0603C | CHIPCAP X5R 10UF 6V3 0603 | 10u | 4V |
| C4443 | Top | S | 9 | 0603C | CHIPCAP X5R 4U7 K 6V3 0603 | 4u7 | 6.3V |
| C4444 | Bottom | T | 9 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |
| C4445 | Bottom | T | 9 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |
| C4446 | Bottom | T | 8 | 0402C | Chipcap X7R 10% 16V 0402 | 10n | 16V |
| C4450 | Bottom | T | 7 | 0402C | Chipcap 5% NP0 | 10p | 50V |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| C4451 | Bottom | T | 7 | 0402C | Chipcap 5% NP0 | 10p | 50V |
| C4452 | Top | I | 4 | 0603C | Cer cap 5% X7R | 10n | 50V |
| C4453 | Bottom | R | 10 | 0402C | Chipcap 5% NP0 | 27p | 50V |
| C4454 | Bottom | R | 10 | 0402C | Chipcap 5% NP0 | 27p | 50V |
| C4459 | Bottom | R | 8 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4460 | Bottom | S | 8 | 0402C | Chipcap 5% NP0 | 56p | 50V |
| C4600 | Top | T | 7 | 0402C | Chipcap 5% NP0 | 22p | 50V |
| C4601 | Top | T | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4602 | Top | T | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4603 | Top | T | 9 | 0603C | CHIPCAP X5R 4U7 K 6V3 0603 | 4u7 | 6.3V |
| C4800 | Top | M | 4 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4801 | Top | O | 5 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |
| C4802 | Top | O | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4803 | Top | M | 4 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4804 | Top | L | 6 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4805 | Top | O | 5 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4806 | Top | N | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4807 | Top | L | 5 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4808 | Top | L | 5 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4809 | Top | M | 4 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4810 | Top | O | 4 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4811 | Top | L | 6 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C4812 | Top | N | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| C5000 | Top | M | 2 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C5001 | Top | M | 2 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C5002 | Top | M | 2 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C5003 | Top | M | 2 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C5004 | Top | M | 4 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C5005 | Top | M | 3 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C5006 | Top | M | 2 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |
| C5200 | Bottom | T | 7 | 0603C | CHIPCAP X5R 4U7 K 6V3 0603 | 4u7 | 6.3V |
| C5201 | Top | R | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C5202 | Top | R | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C6040 | Top | B | 9 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C6041 | Top | D | 9 | 0402C | CHIPCAP X5R 1U K 6V3 0402 | 1u0 | 6.3V |
| C6042 | Top | D | 9 | 0402C | CHIPCAP X5R 1U K 6V3 0402 | 1u0 | 6.3V |
| C6043 | Top | K | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C6044 | Top | J | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C6047 | Top | E | 10 | 0402C | Chipcap 5% NP0 | 100p | 50V |
| C6048 | Top | F | 9 | 0402C | Chipcap +-0.25pF NP0 | 2p2 | 50V |
| C6049 | Top | F | 9 | 0402C | Chipcap +-0.25pF NP0 | 1p8 | 50V |
| C6300 | Top | F | 10 | 0603C | CHIPCAP X5R 4U7 K 6V3 0603 | 4u7 | 6.3V |
| C6301 | Top | F | 9 | 0603C | CHIPCAP X5R 4U7 K 6V3 0603 | 4u7 | 6.3V |
| C6302 | Top | E | 8 | 0402C | CHIPCAP X7R 33N K 10V 0402 | 33n | 10V |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| C6303 | Top | E | 8 | 0402C | Chipcap X7R 10% 16V 0402 | 10n | 16V |
| C6304 | Top | H | 7 | 0603C | CHIPCAP X5R 4U7 K 6V3 0603 | 4u7 | 6.3V |
| C6305 | Top | H | 9 | 0402C | CHIPCAP X7R 33N K 10V 0402 | 33n | 10V |
| C6306 | Top | E | 9 | 0603C | CHIPCAP X5R 4U7 K 6V3 0603 | 4u7 | 6.3V |
| C6310 | Top | H | 9 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C7500 | Top | G | 5 | 0603C | CHIPCAP X5R 4U7 K 6V3 0603 | 4u7 | 6.3V |
| C7501 | Top | E | 3 | 0603C | CHIPCAP X5R 4U7 K 6V3 0603 | 4u7 | 6.3V |
| C7502 | Top | E | 3 | 0603C | CHIPCAP X5R 4U7 K 6V3 0603 | 4u7 | 6.3V |
| C7503 | Top | G | 5 | 0603C | CHIPCAP X5R 4U7 K 6V3 0603 | 4u7 | 6.3V |
| C7504 | Top | E | 2 | 0402C | Chipcap 5% X7R | 3n9 | 50V |
| C7505 | Top | E | 3 | 0402C | Chipcap X7R 10% 16V 0402 | 10n | 16V |
| C7507 | Top | F | 6 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C7508 | Top | F | 2 | 0402C | Chipcap 5% NP0 | 10p | 50V |
| C7509 | Top | F | 2 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C7510 | Top | F | 3 | 0402C | CHPCAP NP0 470P J 50V 0402 | 470p | 50V |
| C7511 | Top | E | 2 | 0402C | CHIPCAP X7R 33N K 10V 0402 | 33n | 10V |
| C7512 | Top | F | 3 | 0603C | CHIPCAP NP0 2N2 G 16V 0603 | 2n2 | 16V |
| C7514 | Top | F | 6 | 0402C | Chipcap +-0.25pF NP0 | 2p2 | 50V |
| C7515 | Top | E | 6 | 0402C | Chipcap +-0.25pF NP0 | 4p7 | 50V |
| C7521 | Top | D | 7 | 0603C | CHIPCAP X5R 4U7 K 6V3 0603 | 4u7 | 6.3V |
| C7522 | Top | C | 5 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| C7541 | Top | C | 4 | 0603C | CHIPCAP X5R 4U7 K 6V3 0603 | 4u7 | 6.3V |
| C7542 | Top | C | 4 | 0603C | CHIPCAP X5R 4U7 K 6V3 0603 | 4u7 | 6.3V |
| C7543 | Top | B | 4 | 0603C | CHIPCAP X5R 4U7 K 6V3 0603 | 4u7 | 6.3V |
| C7544 | Top | D | 3 | 0402C | CERCAP X7R 22N K 16V 0402 | 22n | 16V |
| C7545 | Top | C | 2 | 0402C | Chipcap 5% NP0 | 10p | 50V |
| C7547 | Top | D | 3 | 0402C | Chipcap +-0.25pF NP0 | 2p7 | 50V |
| C7550 | Top | C | 7 | 0402C | Chipcap 5% NP0 | 10p | 50V |
| C7551 | Top | C | 7 | 0402C | Chipcap NP0 2P7 B 50V 0402 | 2p7 | 50V |
| C7552 | Top | C | 8 | 0402C | Chipcap +-0.25pF NP0 | 3p9 | 50V |
| C7555 | Top | F | 6 | 0402C | Chipcap +-0.25pF NP0 | 5p6 | 50V |
| C7560 | Top | F | 7 | 0402C | Chipcap 5% NP0 | 100p | 50V |
| C7561 | Top | D | 7 | 0402C | Chipcap X7R 10% 16V 0402 | 10n | 16V |
| C7583 | Top | C | 2 | 0402C | CHIPCAP NP0 HQ 1.0P B 16V 0402 | 1p0 | 16V |
| D2800 | Top | K | 6 | VFBGA343 | RAP3GS V2.0E-PA VFBGA | ~ | ~ |
| D3000 | Top | K | 6 | FBGA128_EMPTY | COMBO 128M NOR +128M DDR DRAM FBGA128 | 8Mx16/8Mx16 | ~ |
| D4400 | Top | O | 7 | SC70_5 | BUFFER 74LVC1G126 SOT353 | ~ | ~ |
| D4800 | Top | N | 5 | uBGA_289 | HELEN3 PS2.0 N3 SS F761909 C027 UBGA289 | ~ | ~ |
| D5000 | Top | N | 3 | FBGA133_11.6X13.1 | COMBO 512 DDR + 1G NAND FBGA133 PBFREE | 32Mx16/128Mx8 | ~ |
| D5200 | Top | S | 7 | TFBGA84 | HW ACCELERATOR STV0984N | ~ | ~ |
| D6035 | Top | C | 9 | LGA_BTHFM_ES3.6 | BTHFM1.0 BALUN ONLY SOLUTION | ~ | ~ |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| F2000 | Top | R | 10 | 0402_FUSE_AVX_H0.5 | SM FUSE FF 2A 32V 0402 | 2.0A | ~ |
| G2200 | Top | G | 9 | BATTER_EECEP | RTC BACUP CAPAC 311 SIZE FOR 2.6V 4UAH | 2.6V | ~ |
| G7500 | Top | E | 3 | NKG3176B_H1.0 | VCTCXO 38.4MHZ 2.5V 2MA | 38.4MHz | ~ |
| G7501 | Top | F | 3 | VCO_DCS02733 | VCO 3296-3980MHZ 4-BAND MATSUSHITA | 3296-3980MHz | ~ |
| L2000 | Top | R | 10 | 0603_BLM | FERR.BEAD 220R/100M 2A 0R05 0603 | 220R/100MHz | ~ |
| L2001 | Top | N | 10 | 0405_2_MATSU | CHIP BEAD ARRAY 2X1000R 0405 | 2x1000R/100MHz | ~ |
| L2002 | Top | M | 9 | 0405_2_MATSU | CHIP BEAD ARRAY 2X1000R 0405 | 2x1000R/100MHz | ~ |
| L2003 | Top | M | 9 | 0405_2_MATSU | CHIP BEAD ARRAY 2X1000R 0405 | 2x1000R/100MHz | ~ |
| L2004 | Top | O | 10 | FERRITE_0402 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L2005 | Top | O | 10 | FERRITE_0402 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L2006 | Top | O | 10 | FERRITE_0402 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L2010 | Top | M | 10 | 0402L_XL | CHIP COIL 68N J Q17/300M 0402 | 68nH | ~ |
| L2120 | Top | L | 9 | 0603_BLM | FERR.BEAD 220R/100M 2A 0R05 0603 | 220R/100MHz | ~ |
| L2121 | Top | J | 10 | 0603_BLM | FERR.BEAD 220R/100M 2A 0R05 0603 | 220R/100MHz | ~ |
| L2122 | Top | K | 10 | 0603_BLM | FERR.BEAD 220R/100M 2A 0R05 0603 | 220R/100MHz | ~ |
| L2123 | Top | K | 10 | 0603_BLM | FERR.BEAD 220R/100M 2A 0R05 0603 | 220R/100MHz | ~ |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| L2124 | Top | K | 10 | 0603_BLM | FERR.BEAD 220R/ 100M 2A 0R05 0603 | 220R/100MHz | ~ |
| L2202 | Top | J | 8 | 0603_BLM | FERR.BEAD 220R/ 100M 2A 0R05 0603 | 220R/100MHz | ~ |
| L2203 | Top | I | 8 | FERRITE_040 2 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L2204 | Top | I | 9 | FERRITE_040 2 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L2205 | Top | K | 8 | 0603_BLM | FERR.BEAD 220R/ 100M 2A 0R05 0603 | 220R/100MHz | ~ |
| L2206 | Top | I | 8 | FERRITE_040 2 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L2301 | Top | N | 9 | 0603_BLM | FERR.BEAD 220R/ 100M 2A 0R05 0603 | 220R/100MHz | ~ |
| L2302 | Top | M | 9 | CHOKE_SER40 0_H1.2 | INDUCT WW 10UH 0A65 0R35 4X4X1.2 | 10uH | ~ |
| L2304 | Top | O | 9 | CHOKE_SER30 0_H1.5 | CHOKE 22U M 0R7 0.35A 3.0x3.0x1.5 | 22uH | ~ |
| L4200 | Top | M | 8 | CHOKE_SER40 0 | CHOKE 10U 0.8A 0R24 4X4X1.8 | 10uH | ~ |
| L4201 | Top | N | 7 | 0603_BLM | FERR.BEAD 220R/ 100M 2A 0R05 0603 | 220R/100MHz | ~ |
| L4401 | Bottom | S | 7 | FERRITE_040 2 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L4404 | Top | P | 9 | FERRITE_040 2 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L4406 | Bottom | R | 6 | FERRITE_040 2 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L4408 | Bottom | S | 8 | FERRITE_040 2 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| L4411 | Top | S | 10 | 0603_BLM | FERR.BEAD 220R/ 100M 2A 0R05 0603 | 220R/100MHz | ~ |
| L4414 | Top | T | 10 | FERRITE_040 2 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L4417 | Top | S | 10 | FERRITE_040 2 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L4420 | Top | S | 5 | CHOKE_SER30 0_H1.5 | CHOKE 3U3 1.2A 0R096 3X3X1.5 | 3u3H | ~ |
| L4423 | Top | R | 10 | FERRITE_040 2 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L4426 | Bottom | R | 8 | FERRITE_040 2 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L4429 | Bottom | S | 8 | FERRITE_040 2 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L4430 | Top | G | 6 | CHOKE_ELT3K N152C | COIL 0.47MH 50MA 3.3X3.4X1.4MM | 0.47MH | ~ |
| L4435 | Top | H | 5 | FERRITE_040 2 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L4441 | Top | S | 8 | CHOKE_SER30 0 | INDUCT WW 2.2UH 1A2 310 CASE SIZE | 2u2H | ~ |
| L6000 | Top | F | 9 | 0402L | CHIP COIL 2N7 +-0N3 Q29/800M 0402 | 2n7H | ~ |
| L6300 | Top | E | 9 | CHOKE_SER30 0 | INDUCT WW 2.2UH 1A2 310 CASE SIZE | 2u2H | ~ |
| L7500 | Top | G | 4 | FERRITE_040 2 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L7501 | Top | E | 6 | 0402L_POL2 | CHIP COIL 12N J Q30/250MHZ 0402 | 12nH | ~ |
| L7502 | Top | F | 6 | 0402L | CHIP COIL 8N2 J Q25/100MHZ 0402 | 8.2nH | ~ |
| L7520 | Top | D | 4 | FERRITE_FBMJ 1608 | FERRITE BEAD 0R01 28R/100MHZ 0603 | 28R/100MHz | ~ |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| L7540 | Top | C | 4 | CHOKE_SER300_H1.5 | CHOKE 3U3 1.2A 0R096 3X3X1.5 | 3u3H | ~ |
| L7543 | Top | D | 3 | 0402L | CHIP COIL 3N9 +-0N3 Q28/800M 0402 | 3n9H | ~ |
| L7550 | Top | D | 8 | 0402L | CHIP COIL 10N J Q30/800M 0402 | 10nH | ~ |
| L7551 | Top | C | 8 | 0402L | CHIP COIL 18N J Q29/800M 0402 | 18nH | ~ |
| L7555 | Top | F | 6 | 0402L_H0.45 | CHIP COIL 5N6 +-0N1 Q26/1GHZ 0402 | 5n6H | ~ |
| L7582 | Top | C | 2 | FERRITE_LQP10 | CHIP COIL 1N5 +-0N1 Q45/1GHZ 0402 | 1n5H | ~ |
| L7583 | Top | D | 2 | 0402L_W065_POL | CHIP COIL 3N9 +-0N1 Q28/1GHZ 0402 | 3n9H | ~ |
| N2100 | Top | K | 8 | QFN3X3_16A | QUAD ANALOG SWITCH STG3699 QFN16 | ~ | ~ |
| N2101 | Top | K | 9 | XBGA_N16 | AF AMP TPA2012D2 77DB/217HZ WCSP16 | ~ | ~ |
| N2200 | Top | J | 9 | TFBGA_105 | AVILMA 1.05C BB MODULE TFBGA105 | ~ | ~ |
| N2300 | Top | N | 8 | TFBGA64_H1.2 | BETTY V2.1 LF TFBGA64 | ~ | ~ |
| N4200 | Top | M | 8 | USMD_10_2.458X1.899 | DC/DC CONV LM3661-1.40V/1.05V NOPB | ~ | ~ |
| N4420 | Top | T | 5 | SON3024_8 | STEP-UP DC/DC CONV SON3024-8 | ~ | ~ |
| N4430 | Top | G | 5 | MSOP_10 | EL DRIVER D381B 2-7V MSOP-10 | ~ | ~ |
| N4441 | Top | S | 9 | USMD5_1.417X1.087 | DC/DC CONV LM3671TLX-1.82V USMD5 | ~ | ~ |
| N4442 | Bottom | T | 9 | USMD5_1.47X1.04_H0.675 | VREG LP3985ITLX-2.8 NOPB USMD5 | ~ | 3V |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| N4450 | Top | P | 4 | SENSOR_MR10 | MAGNETO RESISTIVE SENSOR MRUS71D SOT4 | ~ | ~ |
| N4600 | Top | T | 7 | IRDA_RPM960 | IRDA 1.15MBPS 2.2MM ROHS | ~ | ~ |
| N6300 | Top | E | 9 | XBGA_N8_2.02X1.02 | DC/DC CONV TPS6231YZD 1.5V CSP8 | ~ | ~ |
| N6301 | Top | E | 8 | LLP_6 | REG LP3981YDX 2.8/NOPB 0.3A LLP-6 | ~ | 2.8V |
| N6302 | Top | F | 8 | LBWA19EBE6 | WLAN SIZE3.0 MODULE | ~ | ~ |
| N6303 | Top | H | 8 | MLF_6 | REG MIC5319YML 500MA ADJ MLF6 | ~ | ADJ |
| N7500 | Top | E | 5 | TFBGA_188_H1.4 | RF SYSTEM MODULE PIHI2.22 9.0X9.0X1 | ~ | ~ |
| N7520 | Top | C | 6 | RF9282E3.6 | PA RF9282 MAGNUM QUADBAND 8X8X1.5 | ~ | ~ |
| N7540 | Top | C | 3 | RF9372_H1.5 | PA MODULE RF9372E5.2 WCDMA 1850-1980MHZ | ~ | ~ |
| N7541 | Top | C | 4 | uBGA8_1.849X1.696 | DC CONV LM3202TLX NOPB REVB USMD8 | ~ | ~ |
| R2006 | Top | M | 9 | BGA11 | ASIP 4 LINES AUDIO FILTER BGA11 | ~ | ~ |
| R2007 | Top | O | 9 | uBGA11_1.6X2.15 | ASIP SILIC USB OTG / ESD BGA11 | ~ | ~ |
| R2009 | Top | N | 9 | 0402R | Resistor 5% 63mW | 220k | ~ |
| R2010 | Top | R | 10 | BGA_4 | ASIP TVS BGA4 | ~ | ~ |
| R2011 | Top | N | 9 | 0402_VAR | CHIP VARISTOR VWM14V VC50V 0402 | 14V/50V | ~ |
| R2012 | Top | N | 9 | 0402_VAR | CHIP VARISTOR VWM14V VC50V 0402 | 14V/50V | ~ |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| R2013 | Top | N | 9 | 0402R | Resistor 5% 63mW | 100R | ~ |
| R2014 | Top | N | 9 | 0402R | Resistor 5% 63mW | 100R | ~ |
| R2015 | Top | N | 10 | 0402R | Resistor 5% 63mW | 120R | ~ |
| R2071 | Top | I | 8 | 0402_NTH5 | NTC RES 47K J B=4050+-3% 0402 | 47k | ~ |
| R2200 | Top | K | 9 | 0402R | Resistor 5% 63mW | 1k0 | ~ |
| R2302 | Top | P | 8 | 0402R | Resistor 5% 63mW | 100R | ~ |
| R2800 | Top | L | 6 | 0402R | Resistor 5% 63mW | 10R | ~ |
| R2801 | Top | K | 4 | 0402R | Resistor 5% 63mW | 4k7 | ~ |
| R2802 | Top | L | 4 | 0402R | Resistor 5% 63mW | 4k7 | ~ |
| R2803 | Top | L | 4 | 0402R | Resistor 5% 63mW | 4k7 | ~ |
| R4400 | Top | N | 7 | 0402R | Resistor 5% 63mW | 100R | ~ |
| R4401 | Top | N | 7 | 0402R | Resistor 5% 63mW | 100R | ~ |
| R4403 | Top | M | 7 | 0402R | Resistor 5% 63mW | 10R | ~ |
| R4405 | Top | P | 10 | 0402R | Resistor 5% 63mW | 100R | ~ |
| R4420 | Top | T | 5 | 0402R_THERM2 | CHIPRES 0W06 6R8 J 0402 | 6R8 | ~ |
| R4424 | Bottom | R | 8 | 0405_2 | VARISTOR ARRAY 2XVWM16V VC50 0405 | 2XVWM16V | ~ |
| R4428 | Top | O | 4 | 0402R | Resistor 5% 63mW | 100k | ~ |
| R4429 | Bottom | Q | 7 | 0402R | Resistor 5% 63mW | 470R | ~ |
| R4430 | Top | I | 7 | 0402R | Resistor 5% 63mW | 47k | ~ |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| R4431 | Top | I | 7 | 0402R | Resistor 5% 63mW | 220k | ~ |
| R4439 | Top | H | 5 | 0402R | Chipres 0W06 5% 0402 | 3M3 | ~ |
| R4440 | Bottom | S | 6 | 0402R | Resistor 5% 63mW | 3k3 | ~ |
| R4441 | Bottom | S | 6 | 0402R | Resistor 5% 63mW | 3k3 | ~ |
| R4442 | Top | M | 7 | 0402R | Resistor 5% 63mW | 10R | ~ |
| R4450 | Bottom | T | 7 | 0402R | Resistor 5% 63mW | 68R | ~ |
| R4601 | Top | T | 9 | 0805R | CHIPRES 0W125 4R7 J 0805 | 4R7 | ~ |
| R4800 | Top | M | 4 | 0402R | Resistor 5% 63mW | 10R | ~ |
| R4809 | Top | L | 5 | 0402R | Resistor 5% 63mW | 1k0 | ~ |
| R5100 | Top | M | 7 | 0402R | Resistor 5% 63mW | 10k | ~ |
| R5200 | Top | R | 6 | 0402R | Resistor 5% 63mW | 4k7 | ~ |
| R5201 | Top | S | 9 | 0402R | Resistor 5% 63mW | 4k7 | ~ |
| R5210 | Top | S | 9 | 0402R | Resistor 5% 63mW | 3k3 | ~ |
| R5211 | Top | S | 9 | 0402R | Resistor 5% 63mW | 3k3 | ~ |
| R5220 | Top | M | 7 | 0402R | Resistor 5% 63mW | 10R | ~ |
| R6030 | Top | D | 8 | 0402R | Resistor 5% 63mW | 3k3 | ~ |
| R6031 | Top | D | 9 | 0402R | Resistor 5% 63mW | 3k3 | ~ |
| R6036 | Top | E | 9 | 0402R | Resistor 5% 63mW | 100k | ~ |
| R6040 | Top | E | 10 | 0402R | Resistor 5% 63mW | 220R | ~ |
| R6302 | Top | D | 8 | 0402R | Resistor 5% 63mW | 1M0 | ~ |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| R6303 | Top | H | 8 | 0402R | CHIPRES 0W06 150K F 200PPM 0402 | 150k | ~ |
| R6304 | Top | H | 8 | 0402R | CHIPRES 0W06 270K F 200PPM 0402 | 270k | ~ |
| R6305 | Top | H | 8 | 0402R | Resistor 1% 63mW | 12k | ~ |
| R6306 | Top | E | 8 | 0402R | Resistor 5% 63mW | 1M0 | ~ |
| R6307 | Top | G | 7 | 0402R | Resistor 5% 63mW | 10k | ~ |
| R7500 | Top | E | 3 | 0402R | Resistor 5% 63mW | 22k | ~ |
| R7501 | Top | F | 6 | 0402R | Resistor 5% 63mW | 4k7 | ~ |
| R7503 | Top | F | 3 | 0402R | CHIPRES 0W06 1K0 F 200PPM 0402 | 1k0 | ~ |
| R7504 | Top | F | 3 | 0402R | CHIPRES 0W06 8K2 F 0402 | 8k2 | ~ |
| R7520 | Top | C | 7 | 0402R | CHIPRES 0W06 27K F 0402 | 27k | ~ |
| R7522 | Top | F | 6 | 0402R | Chipres 0W06 jumper 0402 | 0R | ~ |
| R7528 | Top | F | 2 | 0402R | Chipres 0W06 5R6 J 0402 | 5R6 | ~ |
| R7540 | Top | B | 3 | 0402R | Chipres 0W06 47k F 200ppm 0402 | 47k | ~ |
| R7541 | Top | C | 4 | 0402R | Resistor 5% 63mW | 1k2 | ~ |
| R7543 | Top | D | 2 | 0402R | Resistor 5% 63mW | 10k | ~ |
| R7544 | Top | B | 3 | 0402R | Resistor 5% 63mW | 10R | ~ |
| R7560 | Top | E | 7 | 0402R | Resistor 5% 63mW | 68R | ~ |
| R7561 | Top | E | 7 | 0402R | Resistor 1% 63mW | 12k | ~ |
| R7562 | Top | E | 7 | 0402R | Resistor 5% 63mW | 1k0 | ~ |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| R7563 | Top | D | 3 | 0402R | Resistor 5% 63mW | 560R | ~ |
| R7564 | Top | E | 7 | 0402R | Chipres 0W06 jumper 0402 | 0R | ~ |
| R7566 | Top | E | 7 | 0402R | Chipres 0W06 47k F 200ppm 0402 | 47k | ~ |
| S4440 | Bottom | S | 10 | BUTTON_EVQPUA02 | SM SW TACT SPST 12V 50MA SIDE KEY | ~ | ~ |
| T7500 | Top | F | 6 | TRANS_LDB15 | TRANSF BALUN 2134+-90MHZ 0805 | ~ | ~ |
| T7501 | Top | F | 3 | TRANS_HHM1517A2 | TRANSF BALUN 3800+-550MHZ 0805 | ~ | ~ |
| V2300 | Top | O | 8 | DIODE_PMEG3002 | SCH DI 30V IF 0A2 UFSM 3A IR 10UA SOD882 | ~ | ~ |
| V2303 | Top | O | 8 | SOD323F | SCH DI 30V 2A SOD323F | ~ | ~ |
| V4420 | Bottom | T | 5 | DIODE_PMEG3002 | SCH DI 30V IF 0A2 UFSM 3A IR 10UA SOD882 | ~ | ~ |
| V4430 | Top | J | 7 | SOT_666 | TRX4 4X10K N&P 50V 0A1 0W1 SOT666 | ~ | ~ |
| V4436 | Top | I | 7 | SOT_666 | TRX4 4X10K N&P 50V 0A1 0W1 SOT666 | ~ | ~ |
| V4437 | Top | H | 5 | SC_76 | DI ZEN 100V 6% 200MW SOD323 | ~ | ~ |
| V4438 | Top | I | 5 | SC_76 | DI ZEN 100V 6% 200MW SOD323 | ~ | ~ |
| V6300 | Top | D | 8 | SC79 | SCH DI 1PS79SB31 200MA 30V SOD523 | ~ | ~ |
| V6301 | Top | E | 8 | SC79 | SCH DI 1PS79SB31 200MA 30V SOD523 | ~ | ~ |
| V7560 | Top | E | 7 | SOT323 | Tr NPN 12V 35mA SOT323 | ~ | ~ |
| X2001 | Top | N | 11 | SYSCON_RSD_MINIPOP | SM SYST.CONN 14 POL MINI POP-PORT | ~ | ~ |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| X2060 | Bottom | Q | 5 | TRACEABILITY_PAD | MODULE ID COMPONENT 2.8X1.8X0.3 | ~ | ~ |
| X2070 | Top | P | 6 | BATT_CON_CSS5003 | CONN BATT 3POL SPR 12V 2A SPHINX | ~ | ~ |
| X2700 | Top | J | 2 | SIM_CONN_470191701 | SM SIM CONN 6POL P2.54 H1.7 | ~ | ~ |
| X4400 | Bottom | S | 9 | CON_JAE_FI_J20S_VF15 | CONN COAX 20PIN RECEPT VERTICAL 50V 0.3A | ~ | ~ |
| X4401 | Bottom | S | 6 | CON_IPEX_20394_040E_40 | CONN COAX 40PIN F VERT 50V 0.1A P0.6 | ~ | ~ |
| X4402 | Bottom | S | 10 | CON_IPEX_20394_040E_40 | CONN COAX 40PIN F VERT 50V 0.1A P0.6 | ~ | ~ |
| X4403 | Bottom | Q | 8 | CONN_FH19S_10S_0.5SH | CONN FLEX 1X10 0.5MM 50V 0.5A | ~ | ~ |
| X6030 | Top | F | 10 | RF_SWITCH_MS_156 | SM CONN RF JACK 50R 2W 6GHZ | ~ | ~ |
| X7500 | Top | C | 8 | RF_SWITCH_MS_156 | SM CONN RF JACK 50R 2W 6GHZ | ~ | ~ |
| Z4400 | Bottom | T | 6 | uBGA25_2.47X2.47 | ASIP 10-CH ESD EMI FILTER BGA25 | ~ | ~ |
| Z4401 | Bottom | S | 7 | BGA24_P0.4_H0.67 | ASIP 10-CH LCD FILTER W/ESD BGA24 | ~ | ~ |
| Z4402 | Bottom | R | 7 | uBGA25_2.47X2.47 | ASIP 10-CH ESD EMI FILTER BGA25 | ~ | ~ |
| Z4404 | Top | S | 9 | uBGA25_2.47X2.47 | ASIP 10-CH ESD EMI FILTER BGA25 | ~ | ~ |
| Z4405 | Bottom | S | 5 | FC6_1.27X0.86_P0.4 | ASIP 2-CH MIC EMI/ ESD FILT 400UM | ~ | ~ |
| Z4410 | Bottom | Q | 10 | uBGA25_2.47X2.47 | ASIP 10-CH ESD EMI FILTER BGA25 | ~ | ~ |
| Z4411 | Bottom | R | 8 | FC6_1.27X0.86_P0.4 | ASIP 2-CH MIC EMI/ ESD FILT 400UM | ~ | ~ |
| Z7500 | Top | E | 6 | MODULE_SP_LMZ_137 | TX SAW MODULE GSM 850/900MHZ | 850/900MHz | ~ |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| Z7520 | Top | C | 5 | FILTER_LFTC10N | CER FILT LFL181699TC1 2400-2483MHZ 1.6 | 2400-2483MHz | ~ |
| Z7540 | Top | C | 2 | P_TC3N_12_1_AGI | DUPL BAW 1920-1980/2110-2170MHZ 3.8X3.8 | 1920-1980/2110-2170MHZ | ~ |

## Changes from 1NT_14a to 1NT_15a

**Table 7 Changes from 1NT_14a to 1NT_15a**

| ITEM | SIDE | GRID REF. | | DESCRIPTION AND VALUE | | Note |
|---|---|---|---|---|---|---|
| N7500 | Top | E | 5 | TFBGA_188_H1.4 | RF SYSTEM MODULE PIHI2.22 9.0X9.0X1 | Changed to |
| N7500 | Top | E | 5 | TFBGA_188_H1.4 | PIHI N2.0 RF SYSTEM MODULE | |
| N7520 | Top | C | 6 | RF9282E3.6 | PA RF9282 MAGNUM QUADBAND 8X8X1.5 | Changed to |
| N7520 | Top | C | 6 | RF9282E3.6 | PA RF9282E6.5 MAGNUM QUAD BAND 8X8X1.5 | |

## Component layouts 1NT_14a

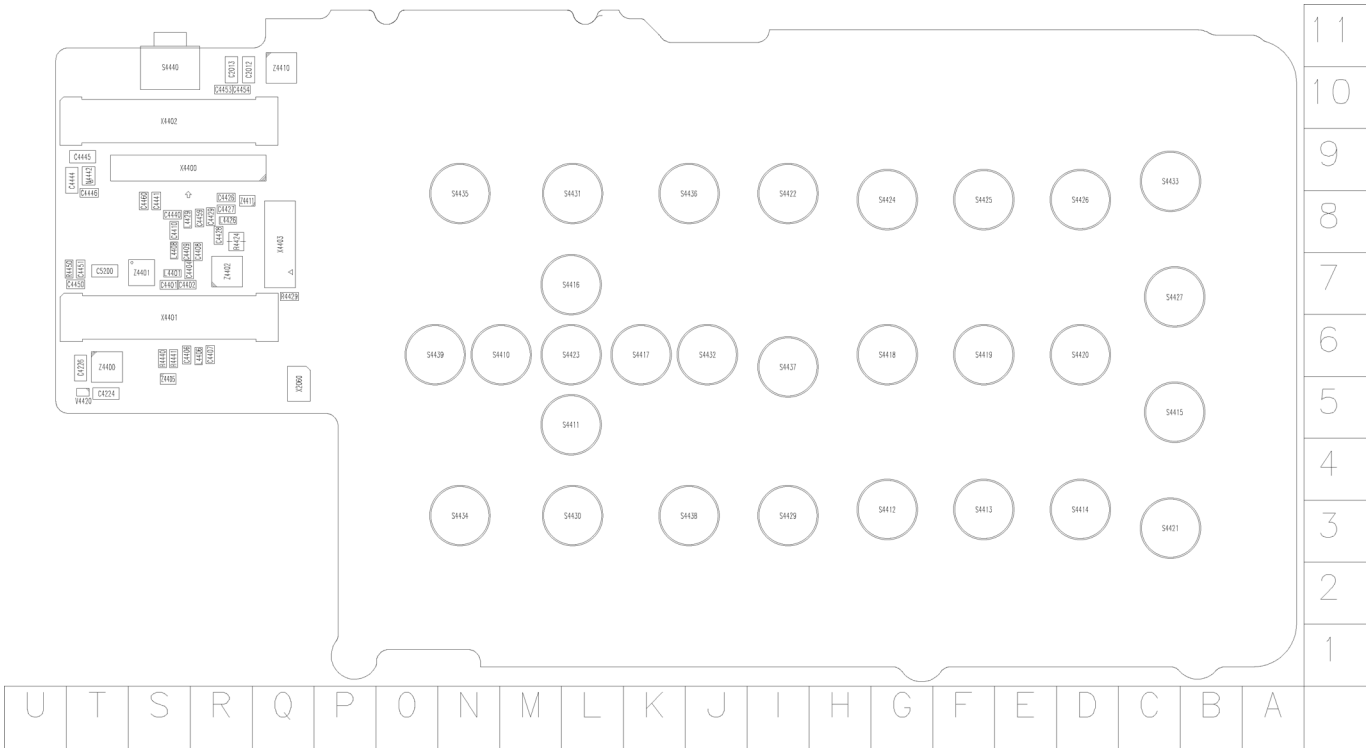


**Figure 4 Component layout 1NT_14a bottom**


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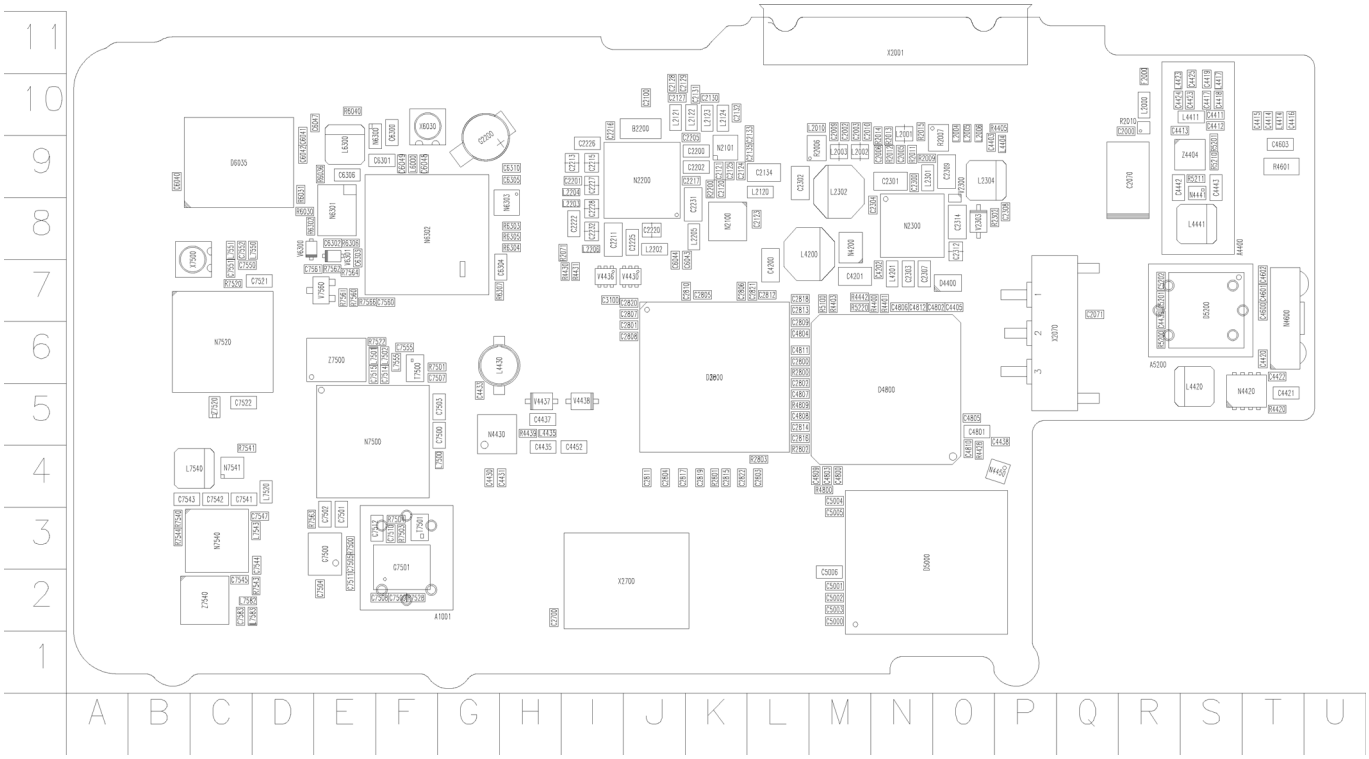

**Figure 5 Component layout 1NT_14a top**

## Component parts lists and layouts 1PH_15a

### Component parts list 1PH_14a

| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| A9000 | Top | I | 6 | SHIELD_040_026489 | SHIELDING CAN 22.6X22.6X2 | ~ | ~ |
| C9000 | Top | F | 7 | 0603C | CHIPCAP X5R 2U2 K 6V3 0603 | 2u2 | 6V3 |
| C9010 | Top | H | 7 | 0402C | Chipcap 5% NP0 | 22p | 50V |
| C9011 | Top | H | 7 | 0402C | Chipcap 5% NP0 | 22p | 50V |
| C9100 | Top | F | 4 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C9101 | Top | F | 4 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |
| C9102 | Top | F | 4 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C9103 | Top | F | 4 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |
| C9110 | Top | I | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C9111 | Top | I | 6 | 0402C | Chipcap X7R 10% 50V 0402 | 1n0 | 50V |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| C9112 | Top | I | 6 | 0603C | CHIPCAP X5R 10UF 6V3 0603 | 10u | 4V |
| C9113 | Top | J | 6 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |
| C9114 | Top | I | 7 | 0402C | Chipcap 5% NP0 | 100p | 50V |
| C9115 | Top | G | 6 | 0402C | CHIPCAP X5R 1U5 K 4V 0402 | 1u5 | 4V |
| C9116 | Top | I | 6 | 0402C | CHIPCAP X5R 1U5 K 4V 0402 | 1u5 | 4V |
| C9117 | Top | J | 6 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C9118 | Top | H | 7 | 0402C | Chipcap X7R 10% 16V 0402 | 10n | 16V |
| C9119 | Top | G | 6 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C9120 | Top | E | 10 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |
| C9121 | Bottom | C | 9 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C9122 | Top | E | 10 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |
| C9123 | Bottom | C | 10 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C9124 | Bottom | C | 11 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C9130 | Bottom | A | 8 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C9150 | Top | I | 4 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |
| C9151 | Top | I | 4 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |
| C9152 | Top | J | 4 | 0603C | CHIPCAP X5R 1U K 16V 0603 | 1u0 | 16V |
| C9153 | Top | I | 4 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |
| C9155 | Top | J | 4 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C9200 | Top | J | 4 | 0402C | Chipcap 5% X7R | 1n0 | 50V |
| C9201 | Top | J | 4 | 0402C | Chipcap 5% X7R | 1n0 | 50V |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| C9202 | Top | N | 10 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |
| C9203 | Top | N | 10 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C9205 | Top | N | 9 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C9206 | Top | N | 10 | 0603C | CHIPCAP X5R 1U K 6V3 0603 | 1u0 | 6.3V |
| C9207 | Top | N | 10 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C9210 | Top | K | 4 | 0402C | Chipcap 5% NP0 | 27p | 50V |
| C9211 | Top | K | 4 | 0402C | Chipcap 5% NP0 | 27p | 50V |
| C9300 | Top | K | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C9303 | Top | K | 6 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C9305 | Top | J | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C9351 | Top | J | 7 | 0603C | CHIPCAP X5R 2U2 K 6V3 0603 | 2u2 | 6V3 |
| C9352 | Top | J | 6 | 0402C | CHIPCAP X7R 33N K 10V 0402 | 33n | 10V |
| C9353 | Top | J | 7 | 0603C | CHIPCAP X5R 2U2 K 6V3 0603 | 2u2 | 6V3 |
| C9400 | Bottom | N | 2 | 0402C | Chipcap 5% NP0 | 100p | 50V |
| C9401 | Top | G | 7 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C9402 | Bottom | N | 2 | 0402C | Chipcap 5% NP0 | 100p | 50V |
| C9404 | Top | J | 5 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V |
| C9410 | Bottom | B | 4 | 0402C | CHIPCAP NP0 1P0 B 50V 0402 | 1p0 | 50V |
| C9412 | Bottom | N | 3 | 0402C | Chipcap +-0.25pF NP0 | 3p3 | 50V |
| C9413 | Bottom | N | 3 | 0402C | Chipcap +-0.25pF NP0 | 3p3 | 50V |
| C9414 | Bottom | N | 3 | 0402C | CHIPCAP NP0 0P5 C 50V 0402 | 0p5 | 50V |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| D9110 | Top | H | 6 | FCBGA121_8.2X8.2 | LCD CONTROLLER S1D13743 1.8V FBGA121 | ~ | ~ |
| D9117 | Top | J | 5 | SC70_5 | BUFFER 74LVC1G126 SOT353 | ~ | ~ |
| D9150 | Top | I | 4 | USMD14_2.433X2.11ABC_0.675 | REG LM2795TLX-NOPB 2.4X2.0X0.8MM | ~ | ~ |
| D9400 | Top | H | 7 | SOT353_H1.1 | BUFFER 1XI/P 74LVC1G125GW SOT353 | ~ | ~ |
| D9401 | Top | I | 7 | SC70_5 | BUFFER 74LVC1G126 SOT353 | ~ | ~ |
| D9402 | Top | J | 7 | SC70_5 | BUFFER 74LVC1G126 SOT353 | ~ | ~ |
| D9403 | Top | I | 7 | SC70_5 | BUFFER 74LVC1G126 SOT353 | ~ | ~ |
| L9000 | Top | F | 7 | FERRITE_0402 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L9001 | Top | F | 5 | FERRITE_0402 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L9003 | Top | F | 5 | FERRITE_0402 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L9004 | Top | F | 8 | 0603_BLM | FERR.BEAD 220R/100M 2A 0R05 0603 | 220R/100MHz | ~ |
| L9100 | Top | F | 5 | FERRITE_0402 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L9110 | Top | I | 6 | FERRITE_0402 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |
| L9111 | Top | I | 5 | FERRITE_0402 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/100MHz | ~ |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| L9117 | Top | G | 7 | FERRITE_0402 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/ 100MHz | ~ |
| L9119 | Top | H | 7 | FERRITE_0402 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/ 100MHz | ~ |
| L9120 | Top | E | 10 | FERRITE_0402 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/ 100MHz | ~ |
| L9121 | Top | E | 10 | FERRITE_0402 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/ 100MHz | ~ |
| L9155 | Top | J | 4 | FERRITE_0402 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/ 100MHz | ~ |
| L9200 | Top | K | 4 | 0405_2_MATSU | CHIP BEAD ARRAY 2X1000R 0405 | 2x1000R/ 100MHz | ~ |
| L9201 | Top | N | 10 | FERRITE_0402 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/ 100MHz | ~ |
| L9202 | Top | N | 10 | FERRITE_0402 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/ 100MHz | ~ |
| L9211 | Top | J | 4 | FERRITE_0402 | FERRITE BEAD 0.6R 600R/100MHZ 0402 | 600R/ 100MHz | ~ |
| L9400 | Bottom | N | 2 | COIL_0603CS | CHIP COIL 27N G Q40/250MHZ 0603 | 27nH | ~ |
| L9402 | Bottom | N | 3 | 0402L | CHIP COIL 10N J Q30/800M 0402 | 10nH | ~ |
| N9110 | Top | J | 7 | FC_4_0.99X0.99 | LI VREG 1.5V/ 150MA WLCSP4 TK63115B | ~ | 1.5V |
| N9130 | Bottom | A | 9 | SENSOR_MR10 | MAGNETO RESISTIVE SENSOR MRUS71D SOT4 | ~ | ~ |
| N9200 | Top | P | 9 | CAMERA_MODULE_ST_VS6451XXXX | CMOS CAMERA MODULE CIF+ (384x320) ACME | ~ | ~ |
| N9300 | Top | K | 7 | PBGA_N48 | LEVEL SHIFT SN74AVCA406ZQCR 1.8/3V BGA48 | ~ | ~ |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| N9350 | Top | J | 6 | LLP_6 | REG LP3981YDX-3.0 LLP3 | ~ | 3V |
| N9400 | Top | J | 5 | SOT23_6_H1.45 | DAC 8-BIT DAC5571 5.5V SOT23 | ~ | ~ |
| N9412 | Top | O | 6 | DVB_HR4.5_V1.0_ES1 | DVB-HR4.5-750 V1.0 MODULE | ~ | ~ |
| R9010 | Top | H | 7 | 0402R | Resistor 5% 63mW | 180R | ~ |
| R9100 | Top | D | 4 | 0603R | CHIPRES 0W1 15R J 0603 | 15R | ~ |
| R9101 | Top | D | 3 | 0603R | CHIPRES 0W1 15R J 0603 | 15R | ~ |
| R9102 | Top | F | 6 | 0402R | Resistor 5% 63mW | 100k | ~ |
| R9103 | Top | F | 6 | 0402R | Resistor 5% 63mW | 100k | ~ |
| R9118 | Top | H | 7 | 0402R | Resistor 5% 63mW | 100R | ~ |
| R9132 | Bottom | A | 8 | 0402R | Resistor 5% 63mW | 100k | ~ |
| R9150 | Top | I | 4 | 0402R | Resistor 5% 63mW | 180R | ~ |
| R9200 | Top | K | 4 | 0402_VAR | CHIP VARISTOR VWM14V VC50V 0402 | 14V/ 50V | ~ |
| R9201 | Top | K | 4 | 0402_VAR | CHIP VARISTOR VWM14V VC50V 0402 | 14V/ 50V | ~ |
| R9202 | Top | F | 10 | 0402_VAR | CHIP VARISTOR VWM14V VC50V 0402 | 14V/ 50V | ~ |
| R9203 | Top | F | 10 | 0402_VAR | CHIP VARISTOR VWM14V VC50V 0402 | 14V/ 50V | ~ |
| R9204 | Top | M | 10 | 0402_VAR | CHIP VARISTOR VWM14V VC50V 0402 | 14V/ 50V | ~ |
| R9205 | Top | M | 10 | 0402_VAR | CHIP VARISTOR VWM14V VC50V 0402 | 14V/ 50V | ~ |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| R9210 | Top | K | 4 | 0402_VAR | CHIP VARISTOR VWM14V VC50V 0402 | 14V/ 50V | ~ |
| R9300 | Top | K | 6 | 0402_VAR | CHIP VARISTOR VWM14V VC50V 0402 | 14V/ 50V | ~ |
| R9304 | Top | K | 6 | 0402R | Resistor 5% 63mW | 12k | ~ |
| R9305 | Top | K | 6 | 0402R | Resistor 5% 63mW | 47R | ~ |
| R9306 | Top | F | 7 | 0402R | Resistor 5% 63mW | 47k | ~ |
| R9307 | Top | F | 6 | 0402R | Resistor 5% 63mW | 47k | ~ |
| R9354 | Top | J | 6 | 0402R | Resistor 5% 63mW | 220k | ~ |
| R9355 | Top | K | 6 | 0402R | Resistor 5% 63mW | 100k | ~ |
| R9400 | Bottom | N | 2 | 0402R | Resistor 5% 63mW | 22k | ~ |
| R9401 | Bottom | N | 2 | 0402R | Resistor 5% 63mW | 22k | ~ |
| R9403 | Top | J | 5 | 0402R | Resistor 5% 63mW | 1k8 | ~ |
| R9410 | Top | K | 5 | 0402R | Resistor 5% 63mW | 47k | ~ |
| R9411 | Top | K | 5 | 0402R | Resistor 5% 63mW | 47k | ~ |
| R9412 | Top | K | 5 | 0402R | Resistor 5% 63mW | 1k0 | ~ |
| R9414 | Top | K | 5 | 0402R | Resistor 5% 63mW | 1k0 | ~ |
| R9420 | Top | M | 7 | 0402R | Resistor 5% 63mW | 100k | ~ |
| S9300 | Bottom | O | 3 | SWITCH_ESE13 V01C | SM SW DETECTOR SWITCH 5V 10MA | ~ | ~ |
| V9120 | Top | C | 9 | VMT3_R | TR DTC143ZM N RB=4K7 RBE=47K VMT3 | ~ | ~ |
| V9150 | Top | D | 9 | VMT3_R | TR DTC143ZM N RB=4K7 RBE=47K VMT3 | ~ | ~ |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| V9151 | Top | D | 9 | VMT3_R | TR DTC143ZM N RB=4K7 RBE=47K VMT3 | ~ | ~ |
| V9400 | Bottom | N | 2 | SCD_80 | CAP.DI BBY57-02W 1/4 16/4P SOD523 | ~ | ~ |
| V9401 | Bottom | N | 2 | SCD_80 | CAP.DI BBY57-02W 1/4 16/4P SOD523 | ~ | ~ |
| V9402 | Top | I | 5 | SC70_5 | DI ZEN LM4040BIM7X-4.1 0.2% V.REF SC70 | ~ | ~ |
| V9410 | Top | K | 5 | VMT3_R | MOSFET N 30V 100MA VMT3 | ~ | ~ |
| V9411 | Top | K | 5 | VMT3_R | MOSFET N 30V 100MA VMT3 | ~ | ~ |
| X9000 | Top | D | 5 | CON_IPEX_20394_040E_40 | CONN COAX 40PIN F VERT 50V 0.1A P0.6 | ~ | ~ |
| X9001 | Top | E | 8 | CON_IPEX_20394_040E_40 | CONN COAX 40PIN F VERT 50V 0.1A P0.6 | ~ | ~ |
| X9010 | Top | F | 10 | TRACEABILITY_PAD | MODULE ID COMPONENT 2.8X1.8X0.3 | ~ | ~ |
| X9011 | Top | F | 7 | C_SPRING_050519 | ANTENNA BOOSTER C-SPRING | ~ | ~ |
| X9012 | Top | M | 5 | C_SPRING_050519 | ANTENNA BOOSTER C-SPRING | ~ | ~ |
| X9013 | Top | M | 8 | C_SPRING_050519 | ANTENNA BOOSTER C-SPRING | ~ | ~ |
| X9014 | Top | F | 5 | C_SPRING_050519 | ANTENNA BOOSTER C-SPRING | ~ | ~ |
| X9015 | Top | K | 3 | C_SPRING_050519 | ANTENNA BOOSTER C-SPRING | ~ | ~ |
| X9016 | Top | H | 3 | C_SPRING_050519 | ANTENNA BOOSTER C-SPRING | ~ | ~ |
| X9017 | Top | O | 3 | C_SPRING_050519 | ANTENNA BOOSTER C-SPRING | ~ | ~ |
| X9018 | Top | J | 3 | C_SPRING_050519 | ANTENNA BOOSTER C-SPRING | ~ | ~ |


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| ITEM | SIDE | GRID REF. | | TYPE | DESCRIPTION AND VALUE | | |
|---|---|---|---|---|---|---|---|
| X9100 | Top | E | 3 | MOLEX_500024_5008 | SM CONN 2X25F P0.4 PWB/PWB | ~ | ~ |
| X9120 | Bottom | B | 10 | CON_DF23C_10DS_BURIED | SM CONN BTB 2X5 F P0.5 | ~ | ~ |
| X9200 | Top | M | 2 | CON_DF23C_10DS_BURIED | SM CONN BTB 2X5 F P0.5 | ~ | ~ |
| X9300 | Bottom | N | 6 | MINISD_SC1S011V1S3 | CONN MINISD PUSH-PUSH 3.3V 0.5A | ~ | ~ |
| X9400 | Bottom | M | 2 | RF_SWITCH_MS_156 | SM CONN RF JACK 50R 2W 6GHZ | ~ | ~ |
| Z9000 | Top | F | 7 | BGA24_P0.4_H0.67 | ASIP 10-CH LCD FILTER W/ESD BGA24 | ~ | ~ |
| Z9001 | Top | E | 4 | BGA24_P0.4_H0.67 | ASIP 10-CH LCD FILTER W/ESD BGA24 | ~ | ~ |
| Z9004 | Top | F | 6 | BGA24_P0.4_H0.67 | ASIP 10-CH LCD FILTER W/ESD BGA24 | ~ | ~ |
| Z9110 | Top | H | 5 | uBGA25_2.47X2.47 | ASIP 10-CH ESD EMI FILTER BGA25 | ~ | ~ |
| Z9111 | Top | H | 5 | uBGA25_2.47X2.47 | ASIP 10-CH ESD EMI FILTER BGA25 | ~ | ~ |
| Z9112 | Top | I | 5 | uBGA25_2.47X2.47 | ASIP 10-CH ESD EMI FILTER BGA25 | ~ | ~ |
| Z9300 | Top | K | 6 | FLIP_CHIP_16_2.01X2.02_H0.715 | MMC ASP HIGH SPEED BGA16 | ~ | ~ |

## Changes from 1PH_14a to 1PH_15a

**Table 8 Changes from 1PH_14a to 1PH_15a**

| ITEM | SIDE | GRID REF. | | DESCRIPTION AND VALUE | | | | | NOTE |
|---|---|---|---|---|---|---|---|---|---|
| C9404 | Top | J | 5 | 0402C_H0.6 | CHIPCAP X5R 100N K 16V 0402 | 100n | 16V | normal, -20%, 20% | Removed |
| R9404 | Top | J | 5 | 0402R | Chipres 0W06 100k F 200ppm 0402 | 100k | ~ | normal, -1%,1% | Added |


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| ITEM | SIDE | GRID REF. | | DESCRIPTION AND VALUE | | | | | NOTE |
|---|---|---|---|---|---|---|---|---|---|
| R9405 | Top | J | 5 | 0402R | CHIPRES 0W06 270K F 200PPM 0402 | 270k | ~ | normal, -1%,1% | Added |
| V9402 | Top | I | 5 | SC70_5 | DI ZEN LM4040BIM 7X-4.1 0.2% V.REF SC70 | ~ | ~ | ~ | Changed to |
| V9402 | Top | I | 5 | SC70_5 | DI ZEN 1.225V +-0.5% 241MW SC70 | ~ | ~ | ~ | |
| R9403 | Top | J | 5 | 0402R | Resistor 5% 63mW | 1k8 | ~ | normal, -5%,5% | Changed to |
| R9403 | Top | J | 5 | 0402R | Resistor 5% 63mW | 1k0 | ~ | normal, -5%,5% | |


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## Component layouts 1PH_14a-1PH_15a

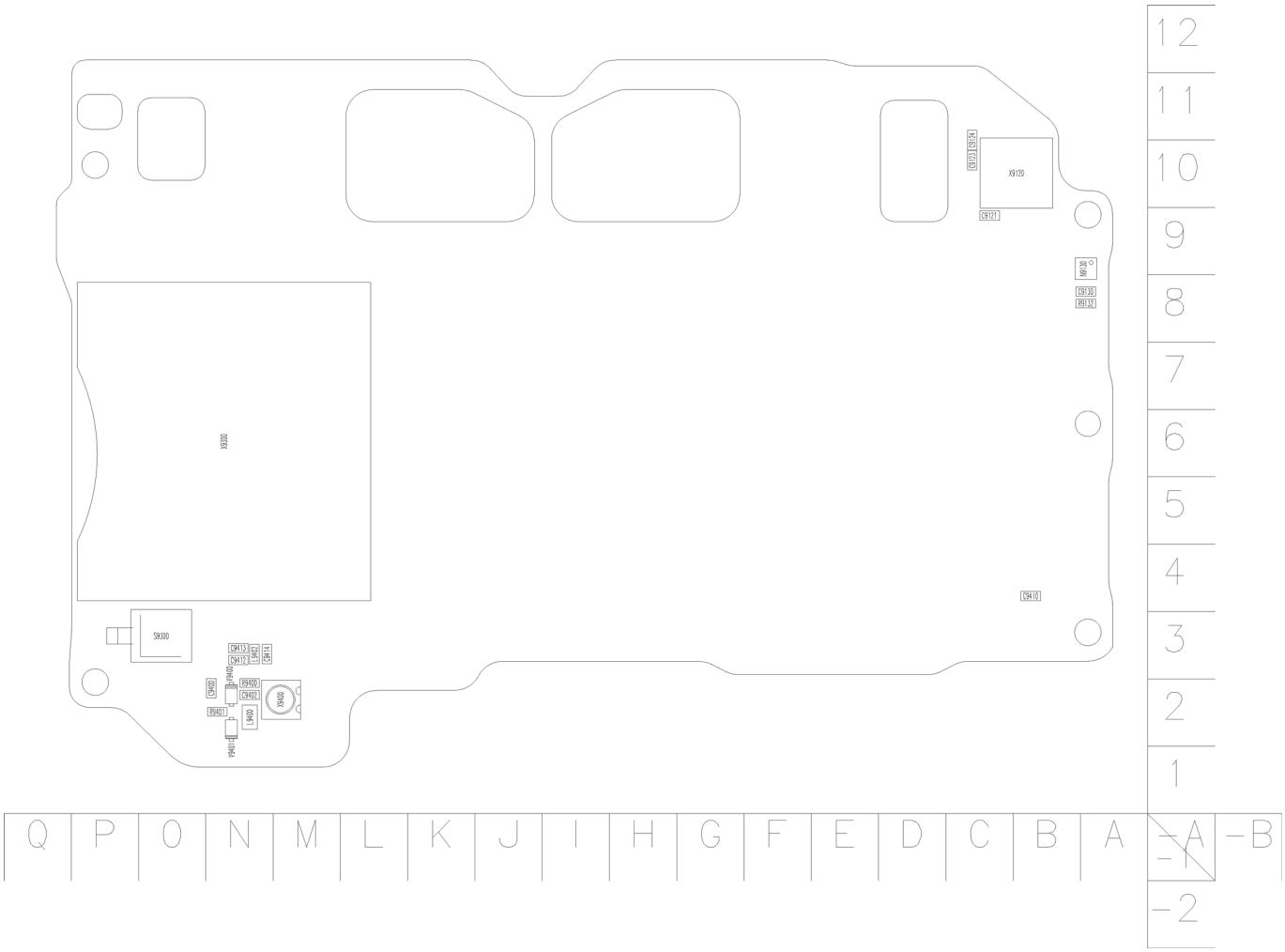


**Figure 6 Component layout 1PH_14a bottom**


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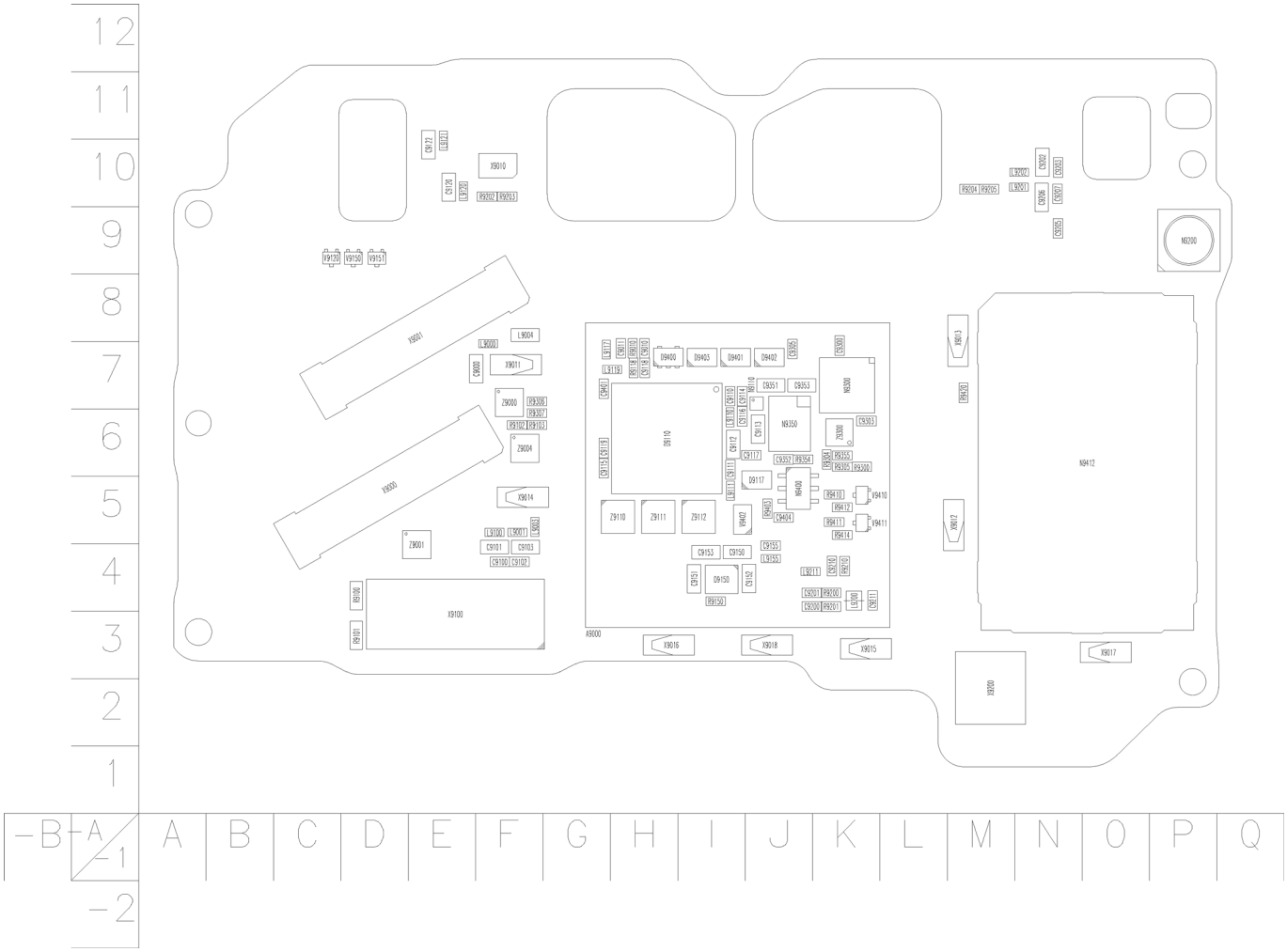

**Figure 7 Component layout 1PH_14a top**


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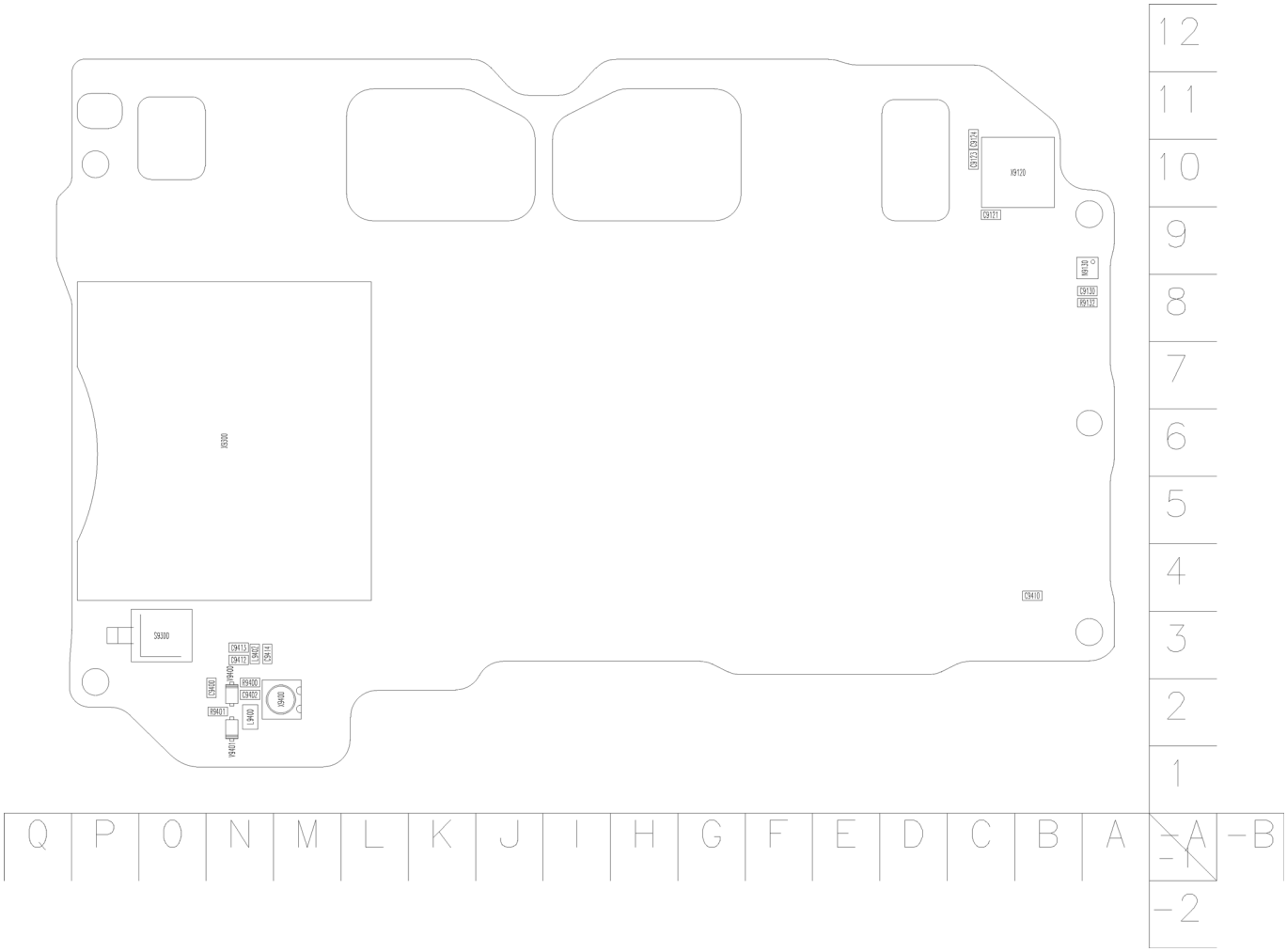


**Figure 8 Component layout 1PH_15a bottom**


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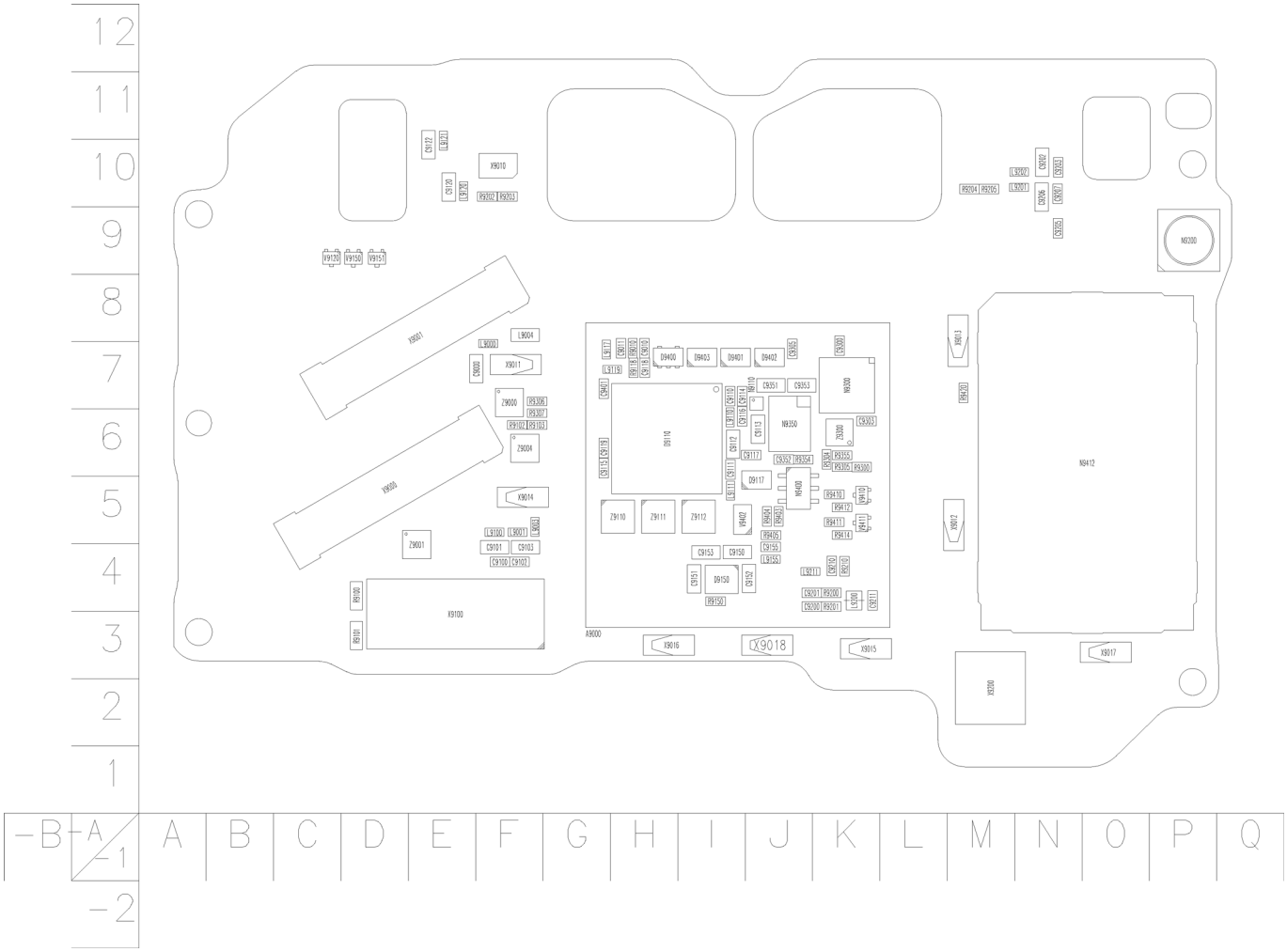

**Figure 9 Component layout 1PH_15a top**


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# 3 — Service Software Instructions


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## *Phoenix* installation steps in brief

### Prerequisites

Recommended hardware requirements:

- Computer processor: Pentium 700 MHz or higher
- RAM 256 MB
- Disk space 100-300 MB

Supported operating systems:

- *Windows 2000* Service Pack 3 or higher
- *Windows XP* Service Pack 1 or higher

### Context

*Phoenix* is a service software for reprogramming, testing and tuning phones.

*Phoenix* installation contains:

- Service software support for all phone models included in the package
- Flash update package files for programming devices
- All needed drivers for:
  - PKD-1 (DK2) dongle
  - DKU-2 USB cable

    **Note:** Separate installation packages for flash update files and drivers are also available, but it is not necessary to use them unless there are updates between *Phoenix* service software releases. If separate update packages are used, they should be used after *Phoenix* and data packages have been installed.

The phone model specific data package includes all changing product specific data:

- Product software binary files
- Files for type label printing
- Validation file for the faultlog repair data reporting system
- All product specific configuration files for *Phoenix* software components

  **Note:** *Phoenix* and phone data packages should only be used as complete installation packages. Uninstallation should be made from the *Windows* Control Panel.

To use *Phoenix*, you need to:

### Steps

1. Connect a PKD-1 (DK2) dongle to the computer parallel port.
2. Install *Phoenix*.
3. Install the phone-specific data package.
4. Configure users.
5. Manage connection settings (depends on the tools you are using).
   - Update FPS-10 software

     **Note:** There is no need to activate FPS-10.
   - Activate SX-4 smart card, if you need tuning and testing functions.

     **Note:** When FPS-10 is used only for product software updates, SX-4 smart card is not needed.


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### Results

*Phoenix* is ready to be used with FPS-10 flash prommer and other service tools.

## Installing *Phoenix*

### Prerequisites

- Check that a dongle is attached to the parallel port of your computer.
- Download the *Phoenix* installation package (for example, *phoenix_service_sw_2004_39_x_xx.exe*) to your computer (in *C:|TEMP*, for instance).
- Close all other programs.
- Depending on your operating system, administrator rights may be required to install *Phoenix*.
- If uninstalling or rebooting is needed at any point, you will be prompted by the InstallShield program.

### Context

At some point during the installation procedure, you may get the following message:

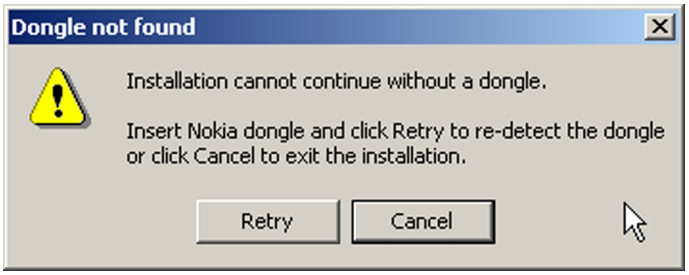


**Figure 10 Dongle not found**

This may be a result of a defective or too old PKD-1 dongle.

Check the COM/parallel ports used. After correcting the problem, you can restart the installation.

For more detailed information, please refer to *Phoenix* Help files.

> **Tip:** Each feature in *Phoenix* has its own Help function, which can be activated while running the program. Press the **F1** key or the feature's **Help** button to activate a Help file.

### Steps

1. To start the installation, run the application file (for example,*phoenix_service_sw_2004_39_x_xx.exe*).
2. In the *Welcome* dialogue, click **Next**.


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3. Read the disclaimer text carefully and click **Yes**.

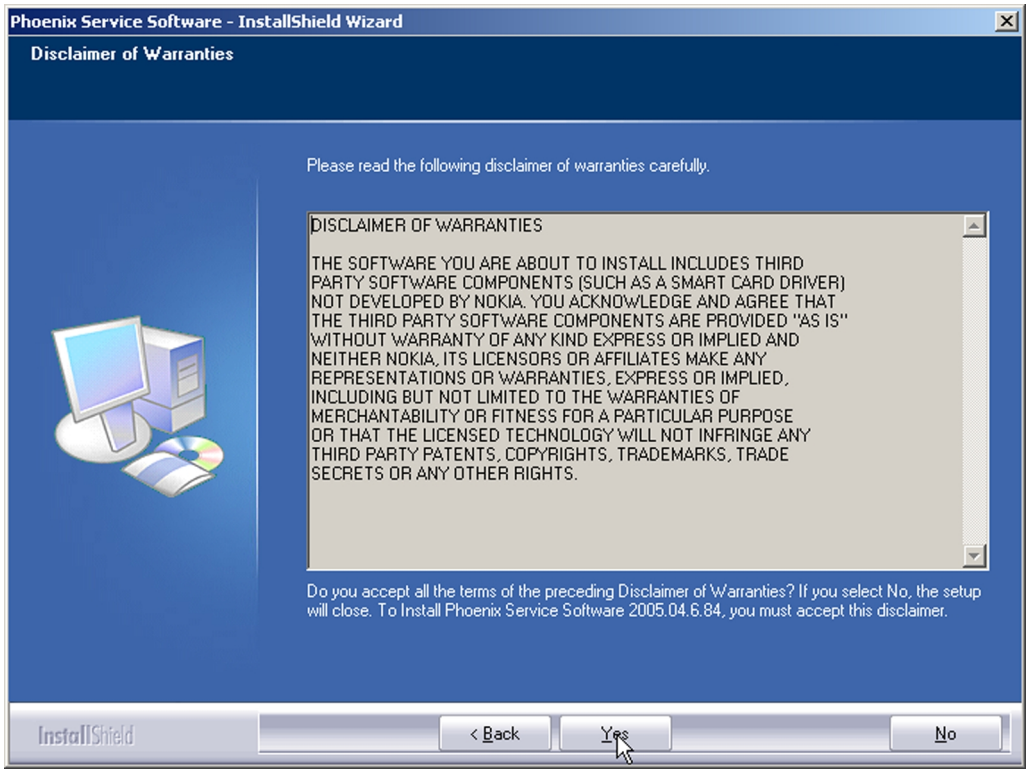


**Figure 11 Disclaimer text**

4. Choose the destination folder.
   The default folder *C:|ProgramFiles|Nokia|Phoenix* is recommended.
5. To continue, click **Next.**
   To choose another location, click **Browse** (not recommended).
6. Wait for the components to be copied.
   The progress of the installation is shown in the *Setup Status* window.
7. Wait for the drivers to be installed and updated.
   The process may take several minutes to complete.
   If the operating system does not require rebooting, the PC components are registered right away.
   If the operating system requires restarting your computer, the Install Shield Wizard will notifies about it.
   Select **Yes...** to reboot the PC immediately or **No...** to reboot the PC manually afterwards.
   After the reboot, all components are registered.

   **Note:** *Phoenix* does not work, if the components have not been registered.


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8. To end the installation, click **Finish**.

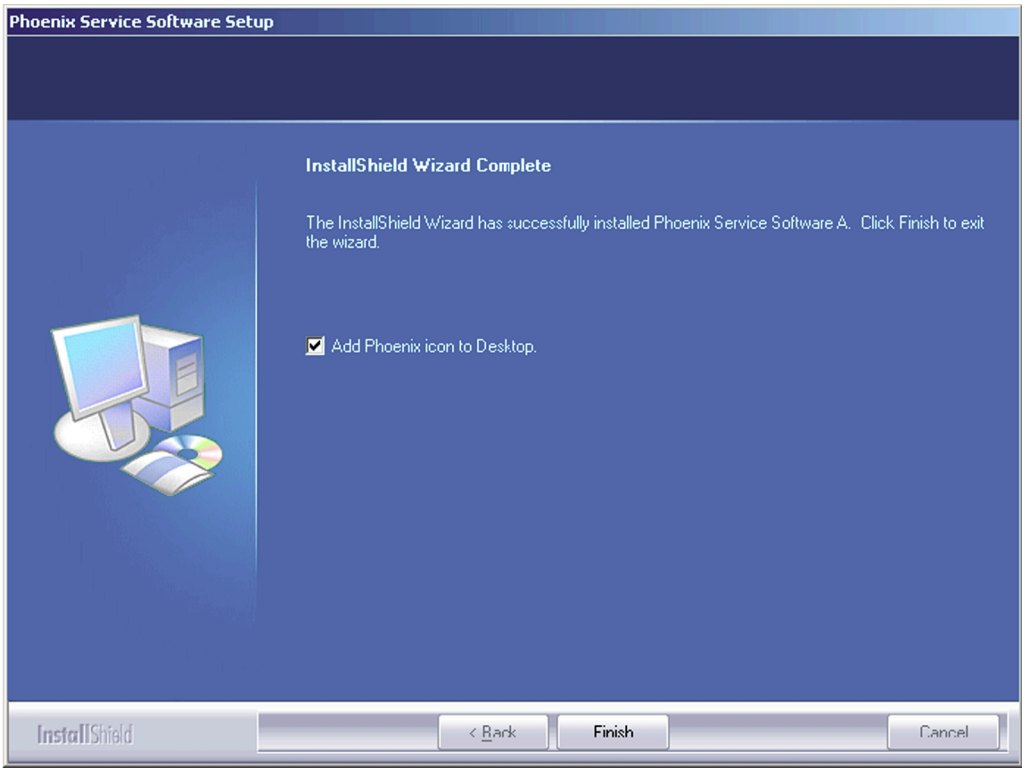


**Figure 12 InstallShield Wizard Complete**

## Next actions

After the installation, *Phoenix* can be used after:

- installing phone model specific data package for *Phoenix*
- configuring users and connections

FPS-10 flash prommer can be used after updating their flash update package files.

# Updating *Phoenix* installation

## Context

- If you already have the *Phoenix* service software installed on your computer, you need to update the software when new versions are released.
- To update *Phoenix*, you need to follow the same steps as when installing it for the first time.
- When you are updating, for example, from version **a14_2004_16_4_47** to **a15_2004_24_7_55**, the update will take place automatically without uninstallation.
- Always use the latest available versions of both *Phoenix* and the phone-specific data package. Instructions can be found in the phone model specific Technical Bulletins and phone data package *readme.txt* files (shown during installation).
- If you try to update *Phoenix* with the same version you already have (for example, **a15_2004_24_7_55** to **a15_2004_24_7_55**), you are asked if you want to uninstall the existing version. In this case you can choose between a total uninstallation or a repair installation in a similar way when choosing to uninstall the application from the *Windows* Control Panel.
- If you try to install an older version (for example, downgrade from **a15_2004_24_7_55** to **a14_2004_16_4_47**), installation will be interrupted.


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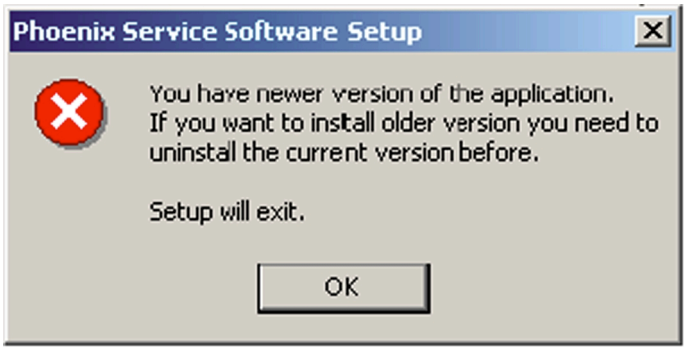


**Figure 13 Installation interrupted**

- Always follow the instructions on the screen.

### Steps

1. Download the installation package to your computer hard disk.
2. Close all other programs.
3. Run the application file (for example, *phoenix_service_sw_2004_39_x_xx.exe*).

### Results

A new *Phoenix* version is installed and driver versions are checked and updated.

## Uninstalling *Phoenix*

### Context

You can uninstall *Phoenix* service software manually from the *Windows* Control Panel.

### Steps

1. Open the **Windows Control Panel**, and choose **Add/Remove Programs**.


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2. To uninstall *Phoenix*, choose **Phoenix Service Software→Change/Remove→Remove** .

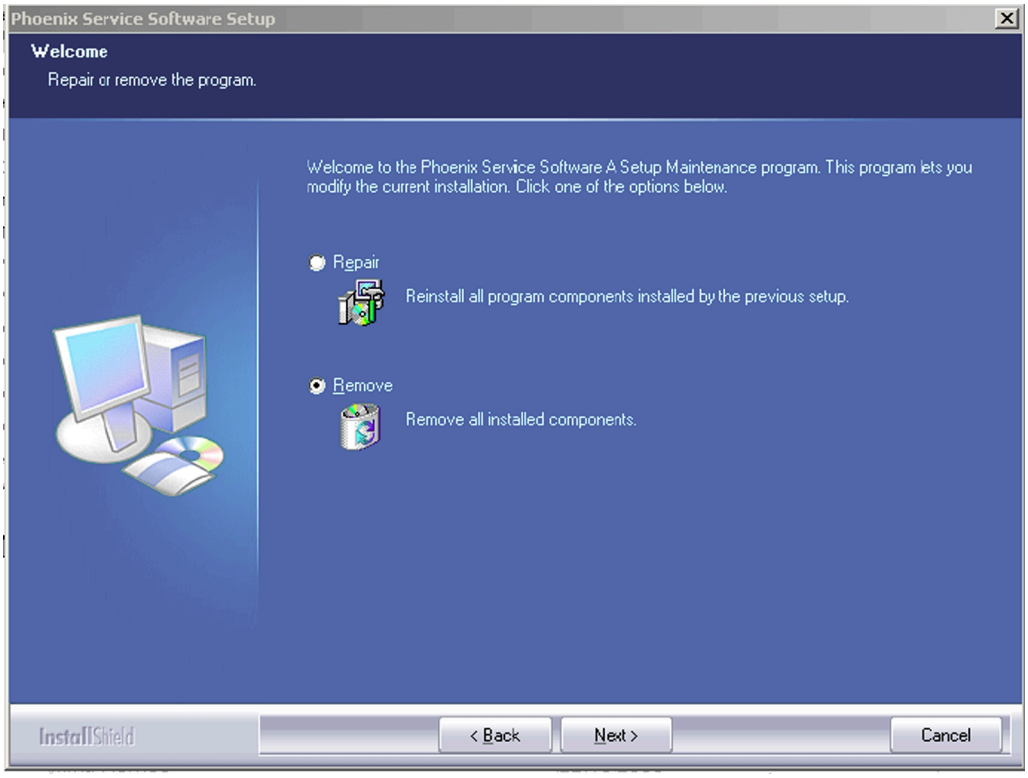


**Figure 14 Remove program**

The progress of the uninstallation is shown.

3. If the operating system does not require rebooting, click **Finish** to complete.

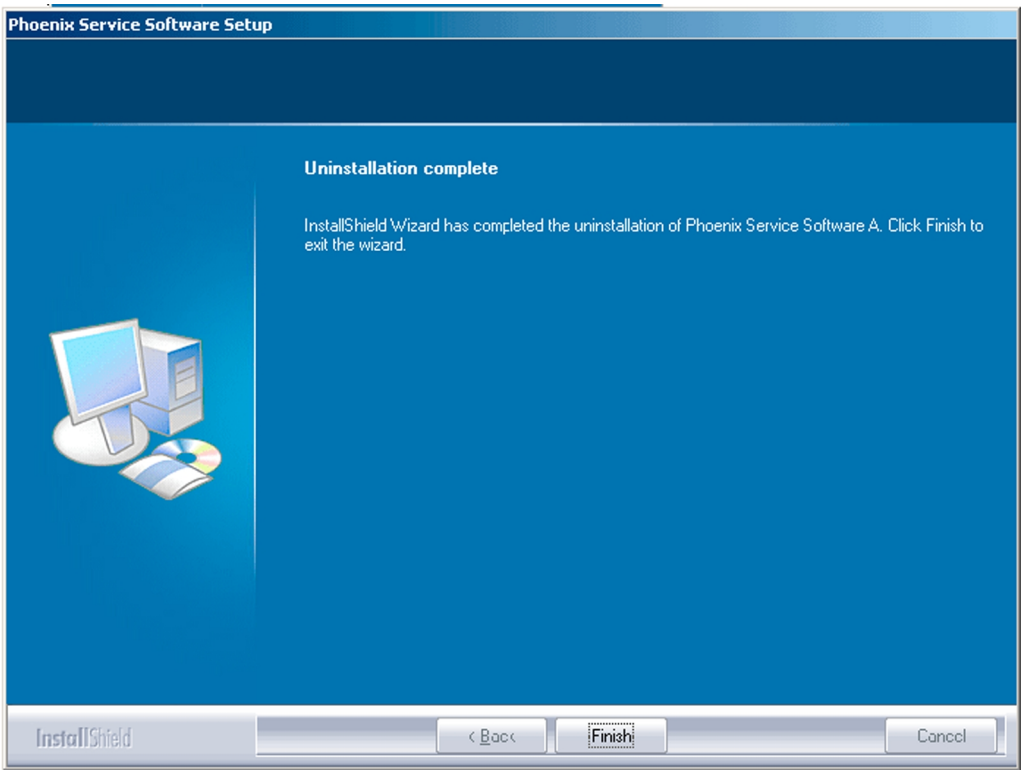


**Figure 15 Finish uninstallation**


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If the operating system requires rebooting, InstallShield Wizard will notify you. Select **Yes...** to reboot the PC immediately and **No...** to reboot the PC manually afterwards.

## Repairing *Phoenix* installation

### Context

If you experience any problems with the service software or suspect that files have been lost, use the repair function before completely reinstalling *Phoenix*.

**Note:** The original installation package (for example, *phoenix_service_sw_a15_2004_24_7_55.exe*) must be found on your PC when you run the repair setup.

### Steps

1. Open **Windows Control Panel→Add/Remove Programs** .
2. Choose **Phoenix Service Software→Change/Remove** .
3. In the following view, select **Repair**.

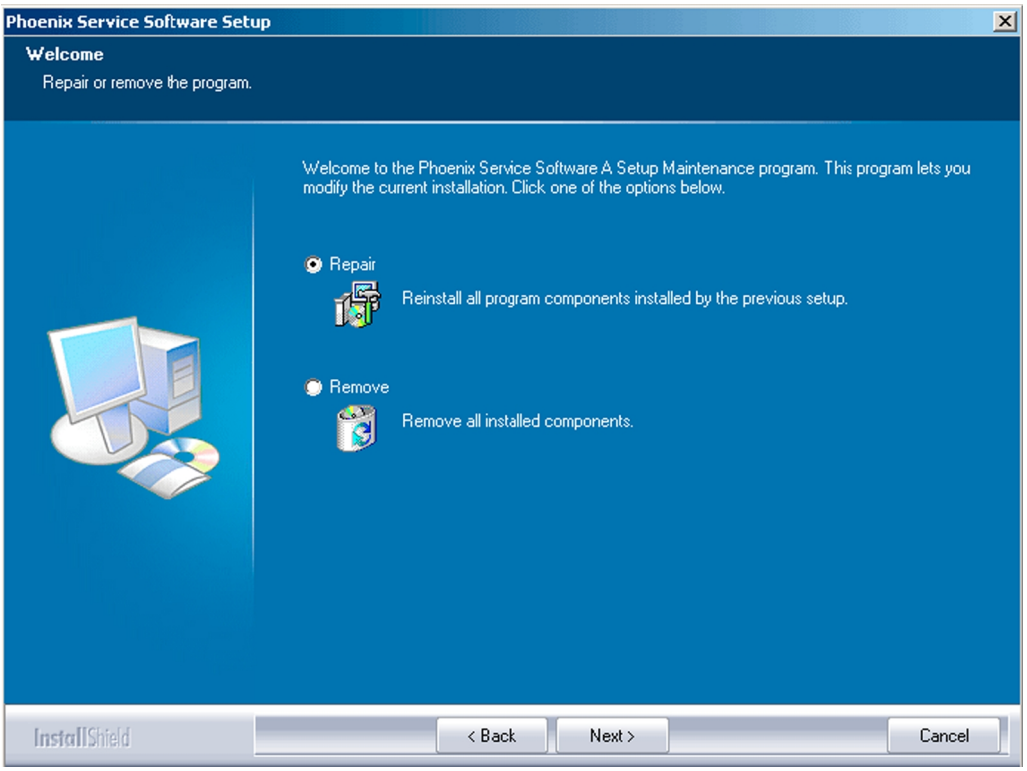


**Figure 16 Repair program**

*Phoenix* reinstalls components and registers them.

The procedure is the same as when updating *Phoenix*.

4. To complete the repair, click **Finish**.

## Phone data package overview

Each product has its own data package (DP). The product data package contains all product-specific data files to make the Phoenix service software and tools usable with a certain phone model.

The phone data package contains the following:

- Product software binary files


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- Files for type label printing
- Validation file for the fault log repair data reporting system
- All product-specific configuration files for Phoenix software components

Data files are stored in **C:\Program Files\Nokia\Phoenix** (default).

## Installing phone data package

### Prerequisites

- A phone-specific data package contains all data required for the *Phoenix* service software and service tools to be used with a certain phone model.
- Check that a dongle is attached to the parallel port of your computer.
- Install *Phoenix* service software.
- Download the installation package (for example, *XX-XX_dp_EA_v_1_0.exe*) to your computer (for example, in C:\TEMP).
- Close all other programs.

(XX-XX = type designator of the product)

If you already have *Phoenix* installed on your computer, you will need to update it when a new version is released.

> **Note:** Often *Phoenix* and the phone-specific data package come in pairs, meaning that a certain version of *Phoenix* can only be used with a certain version of a data package. Always use the latest available versions of both. Instructions can be found in phone-specific Technical Bulletins and *readme.txt* files of data packages.

### Steps

1. To start the installation, run the application file (for example, *XX-XX_dp_EA_ v_1_0.exe*),

   Wait for the installation files to be extracted.


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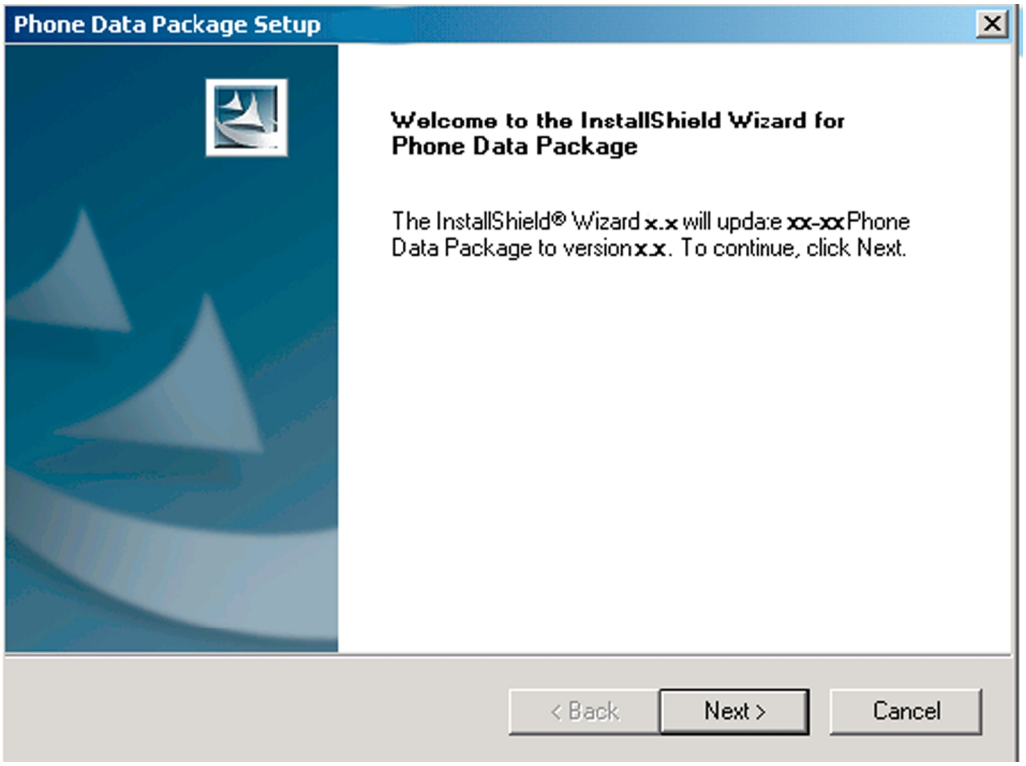
2. Click **Next**.




3. In the following view you can see the contents of the data package. Read the text carefully. There is information about the *Phoenix* version required with this data package.

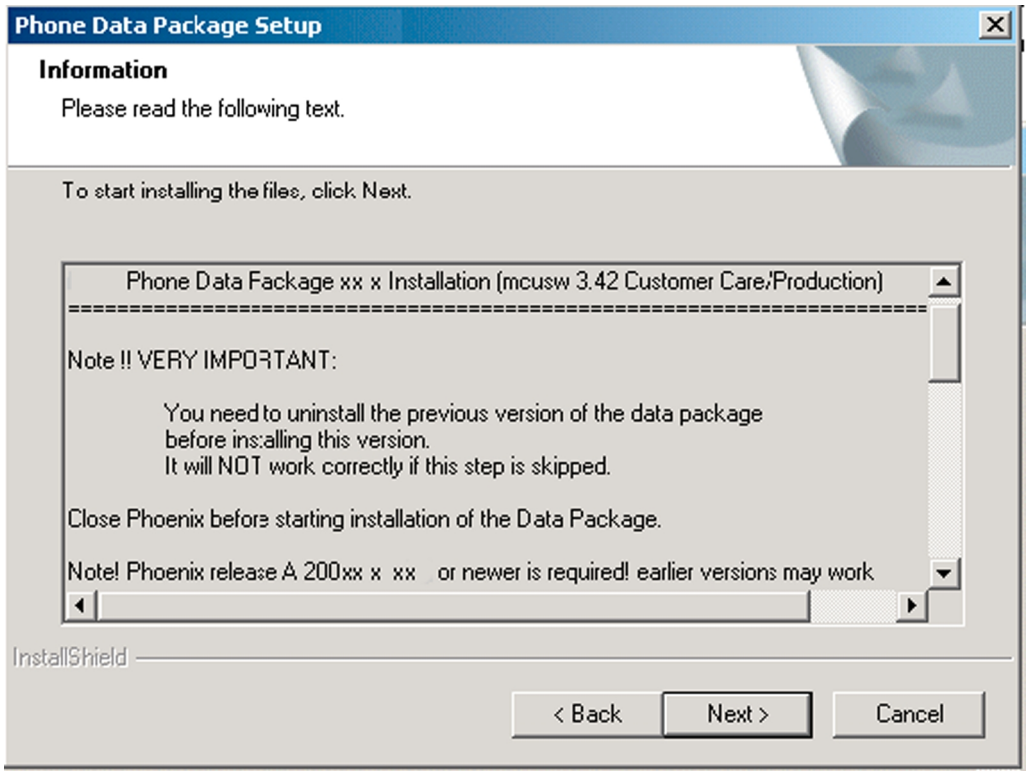



**Figure 17 Data package setup information**

4. To continue, click **Next**.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5. Choose the destination folder, and click **Next** to continue.

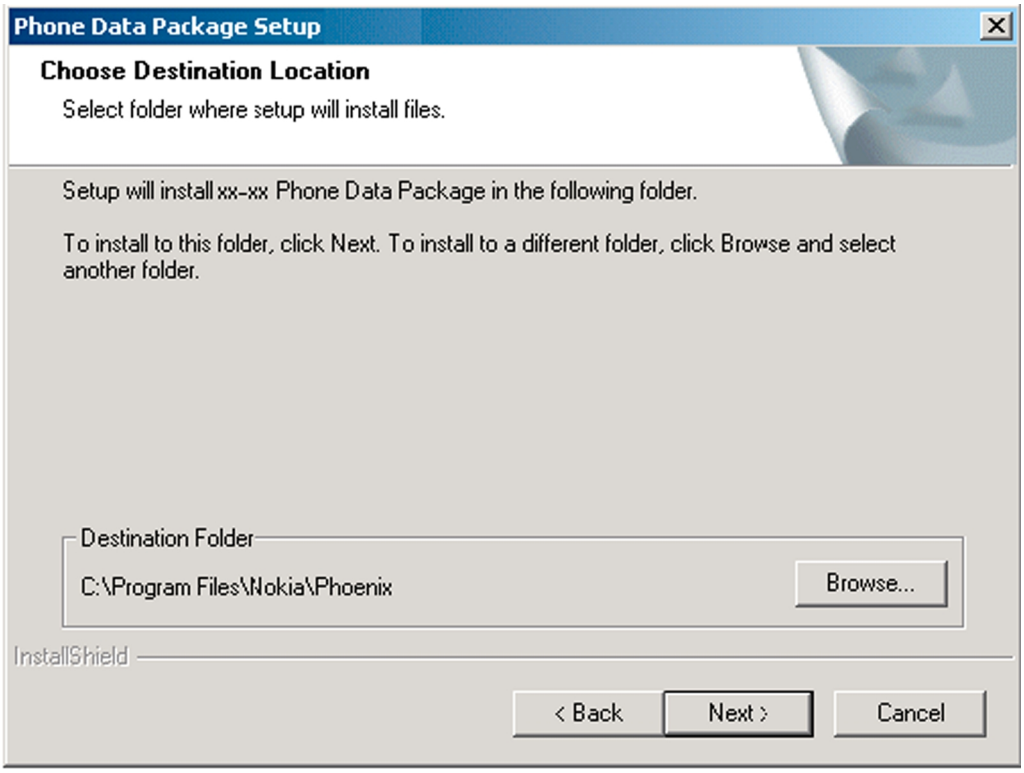
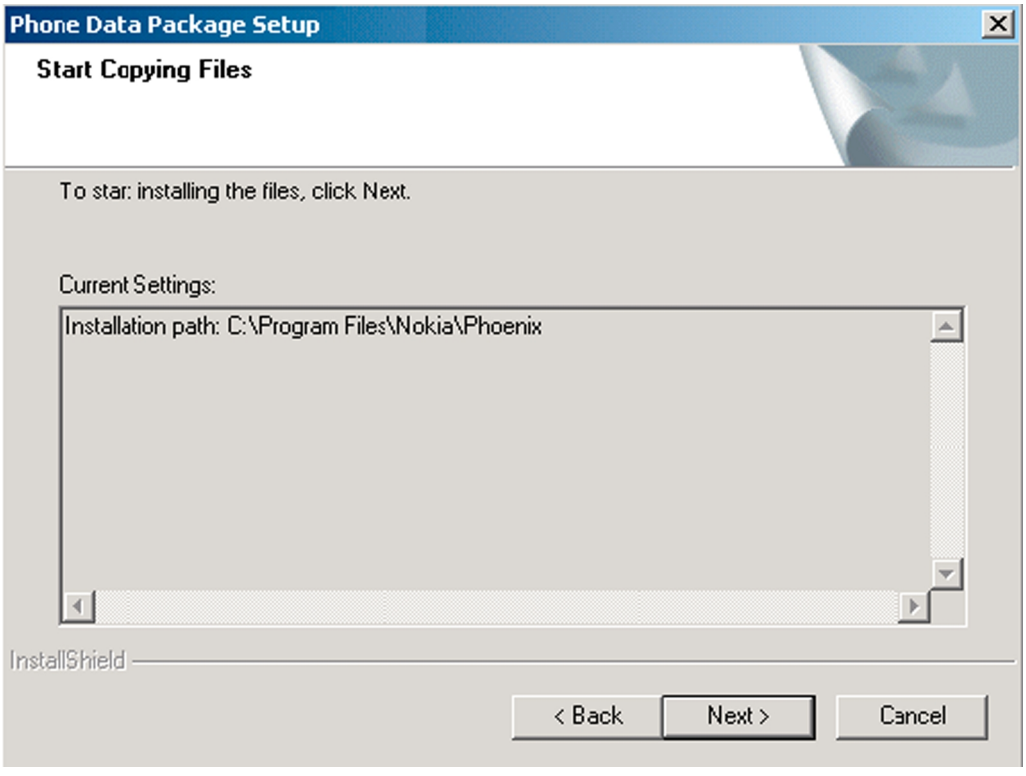



**Figure 18 Data package destination folder**

The InstallShield Wizard checks where *Phoenix* is installed, and the directory is shown.

6. To start copying the files, click **Next**.





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Phone model specific files are installed. Please wait.

7. To complete the installation, click **Finish**.

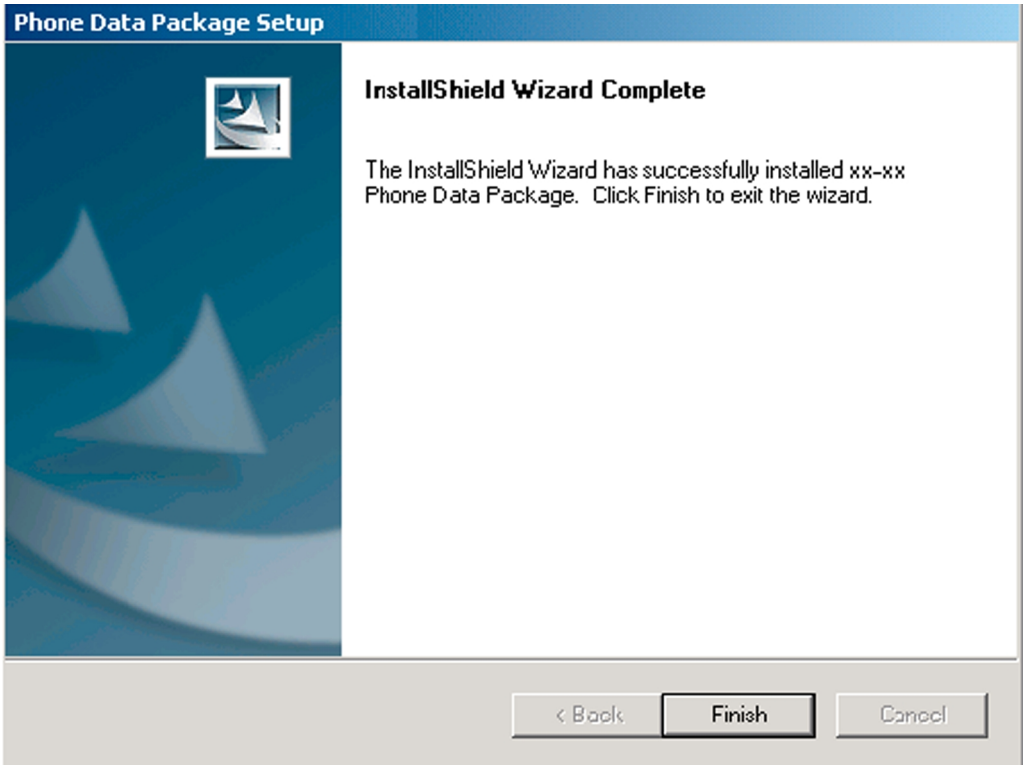


**Figure 19 InstallShield Wizard Complete**

### Next actions

*Phoenix* can be used for flashing phones and printing type labels after:

- Configuring users
- Managing connections

FPS-10 can be used after updating their flash update package files.

## Uninstalling phone data package

### Context

There is no need to uninstall an older version of a data package, unless instructions to do so are given in the *readme.txt* file of the data package and bulletins related to the release.

Please read all related documents carefully.

### Steps

1. Locate the data package installation file (e.g. *XX-XX_dp_EA_v_1_0.exe*) from your computer.
2. To start the uninstallation procedure, double-click the data package installation file.


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3. To uninstall the data package, click **OK** or to interrupt the uninstallation, click **Cancel**.

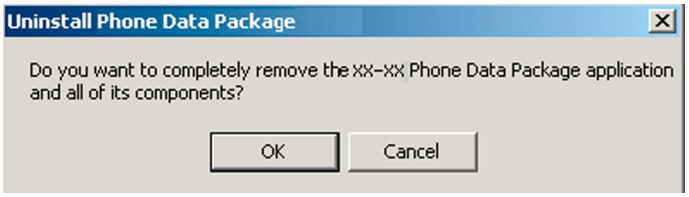


**Figure 20 Uninstalling phone data package**

4. When the data package is uninstalled, click **Finish**.

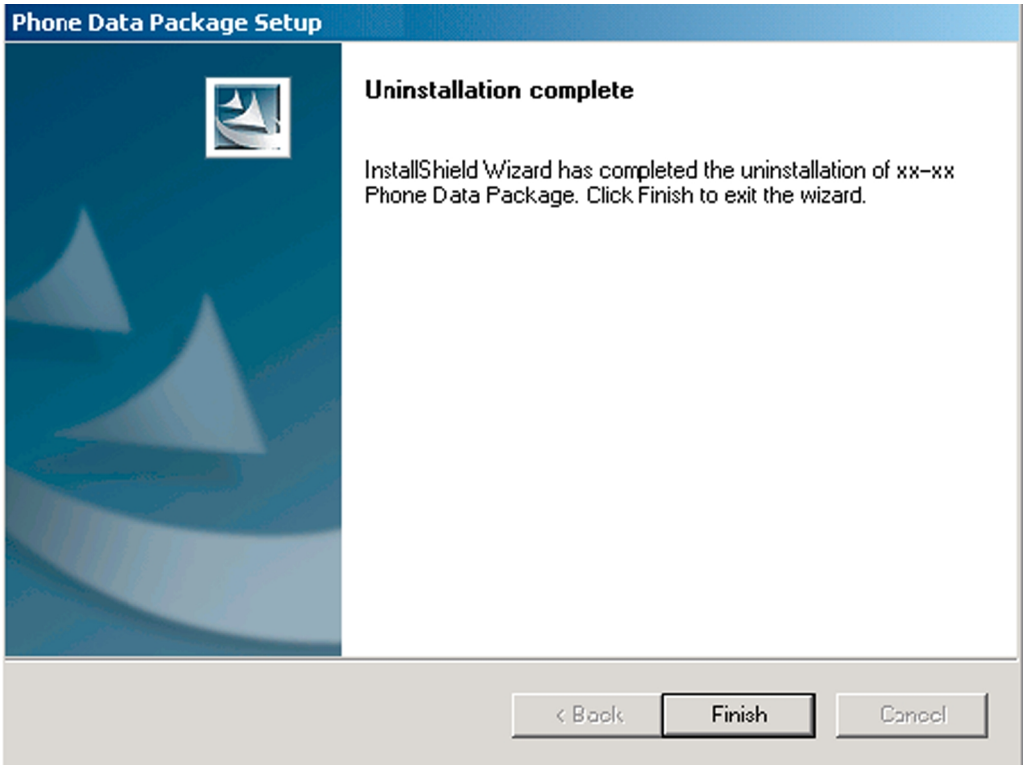


**Figure 21 Finishing data package uninstallation**

## Alternative steps

- You can also uninstall the data package manually from **Control Panel→Add/Remove Programs→xx-xx* Phone Data Package** . (*= type designator of the phone).


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## Configuring users in *Phoenix*

### Steps

1. Start *Phoenix* service software, and log in.

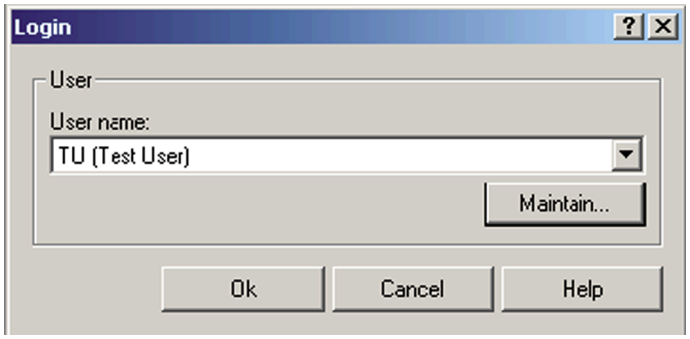


**Figure 22 Phoenix login**

   If the user ID is already configured, select s/he from the *User name* drop-down list, and click **OK**.
2. To add a new user, or to edit existing ones, click **Maintain**.
3. To add a new user, click **New**.
4. Type in the name and initials of the user, and click **OK**.
   The user is added to the user name list.
5. Select the desired user from the *User name* drop-down list, and click **OK**.

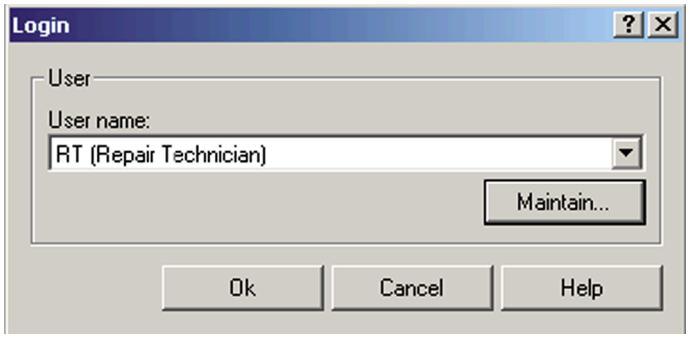


**Figure 23 New user configured**

## Managing connections in *Phoenix*

### Context

With the **Manage Connections** feature you can edit and delete existing connections or create new ones.

> **Note:** After choosing the desired connection, and connecting the phone to a PC for the first time, allow the PC to install the USB device drivers first. Please note that this may take some time to complete.
>
> If there are problems after the driver installation, check that the USB connection is active from the **Windows Control Panel**. If the problem persists, contact the local PC support.

### Steps

1. Start *Phoenix*, and log in.
2. Choose **File→Manage Connections...** .


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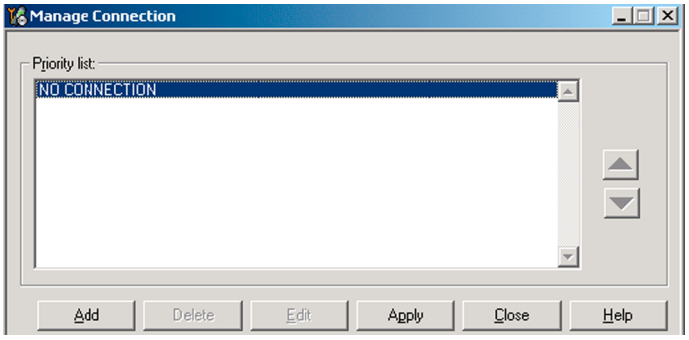
3. To add a new connection, click **Add**.




4. Select **Manual** mode, and click **Next** to continue.

   If you want to create the connection using the Connection Wizard, connect the tools and a phone to your PC. The wizard will automatically try to configure the correct connection.

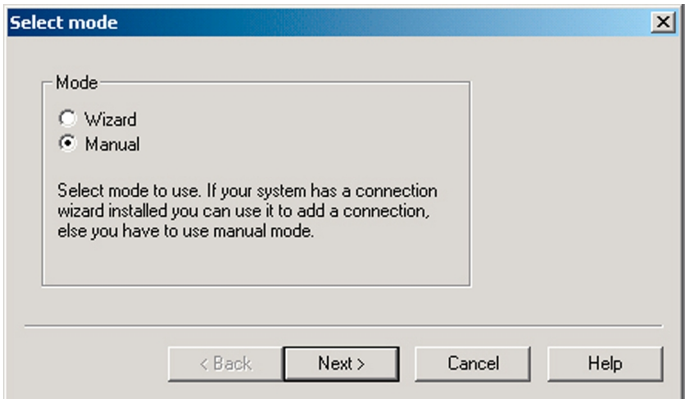



**Figure 24 Select mode: Manual**

i For an FPS-10 flash prommer with a **USB Connection**, choose the following connection settings:
   - Media: **FPS-10 USB**
   - DEVICE_INDEX: **0**
   - SERIAL_NUM: See Serial No from the label attached to the bottom of FPS-10
   - ACTIVE_MEDIA: **USB**

ii For an FPS-10 flash prommer with a **LAN connection**, choose the following connection settings:
   - Media: **FPS-10 TCP/IP**
   - NET_SERV_NAME: Click **Scan...**. Choose your own FPS-10 device based on the correct MAC address. See Serial No from the label attached to the bottom of your FPS-10.
   - PORT_NUM: Use the default value, and click **Next**.
   - PROTOCOL_FAMILY: Use the default value, and click **Next**.
   - SOCKET TYPE: Use the default value, and click **Next**.
   - TX_BUFFER_SIZE: Use the default value, and click **Next**.
   - RX_BUFFER_SIZE: Use the default value, and click **Next**.

iii For an FPS-8 flash prommer, choose the following connection settings:
   - Media: FPS-8
   - PORT_NUM: COM Port where FPS-8 is connected
   - COMBOX_DEF_MEDIA: **FBUS**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iv For a plain **USB connection**, choose the following connection settings:

**Note:** First connect the DKU-2 USB cable between the PC USB port and phone.

- Media: USB

5. To complete the configuration, click **Finish**.
6. Click the connection you want to activate. Use the up/down arrows located on the right hand side to move it on top of the list, then click **Apply**.

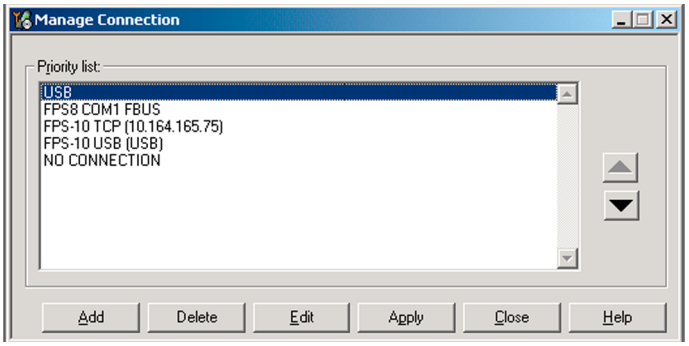


**Figure 25 Connections list**

The connection is activated, and it can be used after closing the *Manage Connection* window.

The connection information is shown at the right hand bottom corner of the screen.

**Figure 26 Connection information**

7. To use the connection, connect the phone to your PC with correct service tools. Make sure the phone is switched on, and then choose **File→Scan Product** .

## Results

The product support module information appears in the status bar:

**Figure 27 Product support module information (example from RM-1)**

# Installing flash support files for FPS-10

## Prerequisites

**Note:** You need to install flash support files for FPS-10 only, if you don't have the latest Phoenix available or the flash support files have changed after the latest Phoenix release.

- Flash support files are installed automatically, when you install Phoenix. Use Phoenix packages later than June 2006.
- Normally it is enough to install Phoenix and the phone-specific data package because the Phoenix installation always includes the latest flash update package files for FPS-10.
- A separate installation package for flash support files is available, and the files can be updated according to this instruction, if updates appear between new Phoenix / data package releases

## Context

If you are not using a separate installation package, you can skip this section and continue with updating FPS-10 flash prommer software after installing a new phone data package.


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## Steps

1. To begin installation, double- click *flash_update_x_yy.exe* .

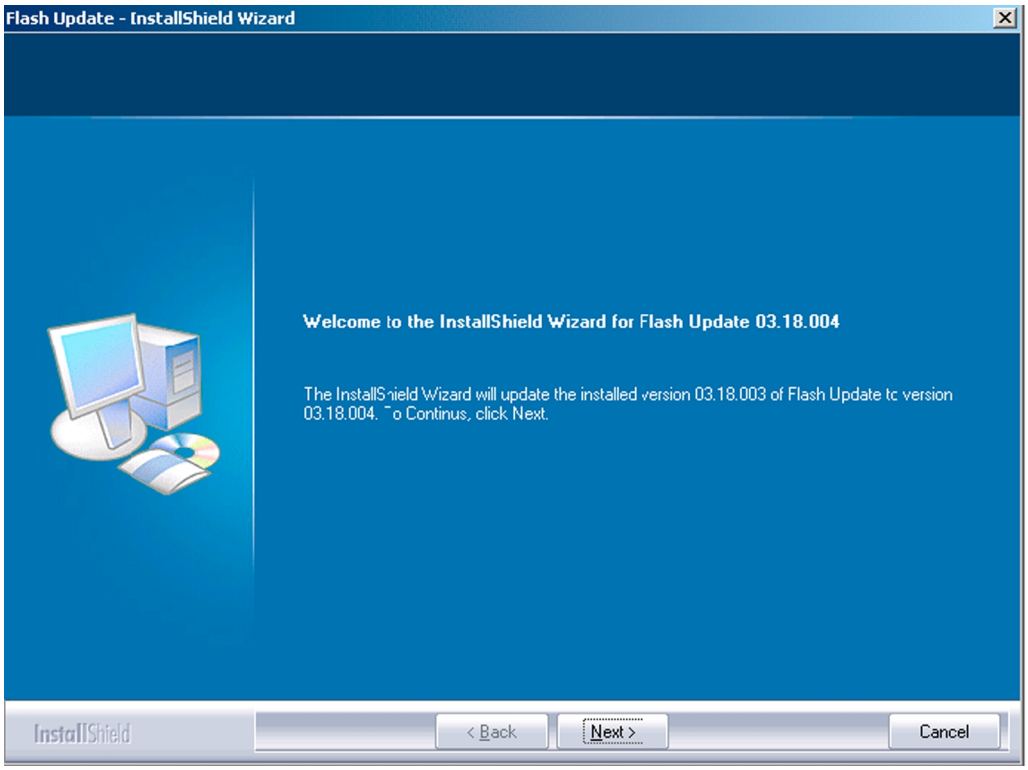


**Figure 28 Flash update welcome dialog**

If the same version of Flash Update package already exists, and you want to reinstall it, the previous package is first uninstalled. Restart installation again after that.

2. If you try to downgrade the existing version to older ones, the setup will be aborted. If you really want to downgrade, uninstall newer files manually from **Control Panel** and then rerun the installation again.

**Figure 29 Flash installation interrupted**

If an older version exists on your PC and it needs to be updated, click **Next** to continue installation.


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3. It is highly recommended to install the files to the default destination folder *C:|Program Files|Nokia |Phoenix*. Click **Next** to continue.

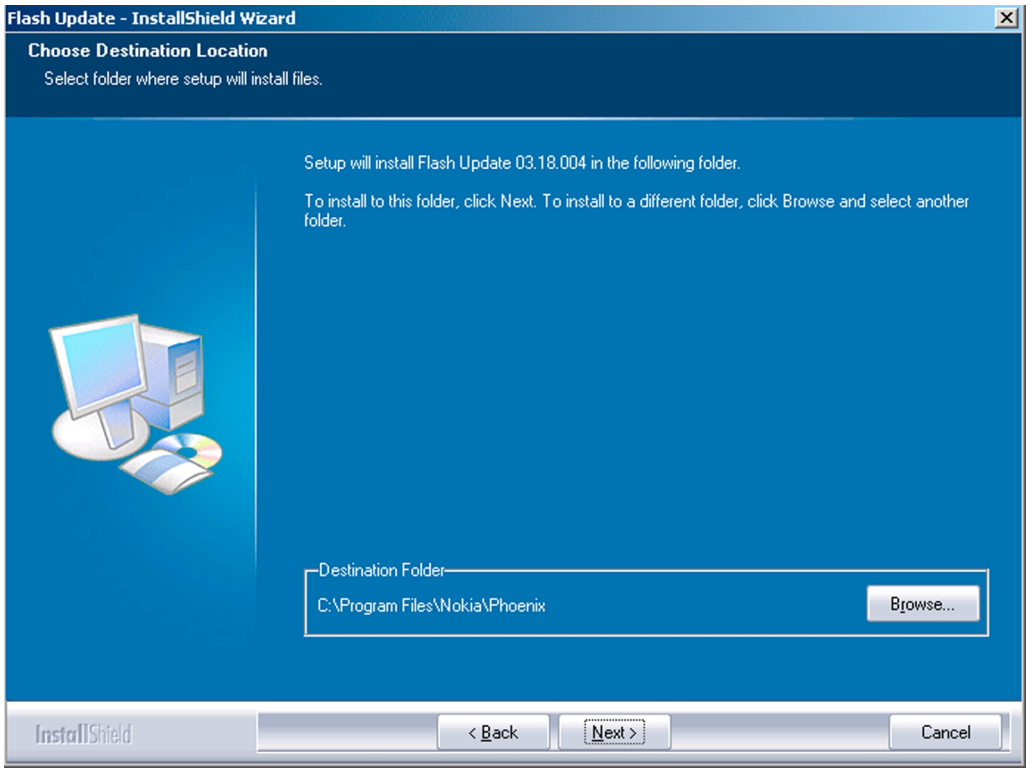


**Figure 30 Flash destination folder**

When installing the flash update files for the first time you may choose another location by selecting **Browse**. However, this is not recommended.


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4. To complete the installation procedure, click **Finish** .

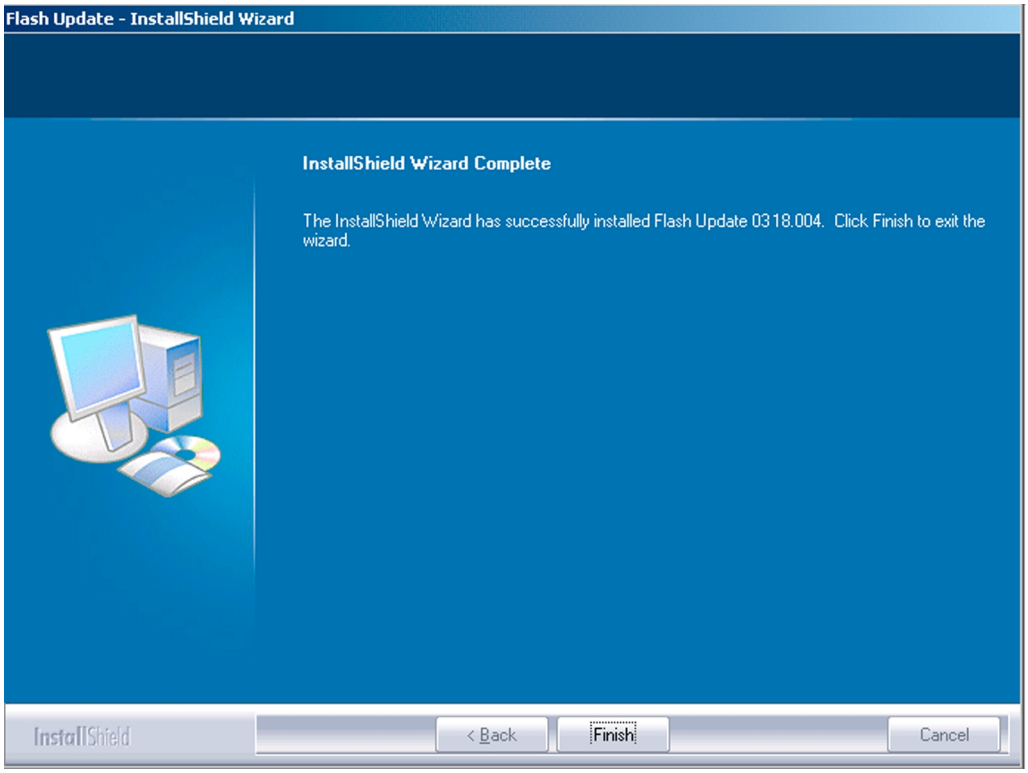


**Figure 31 Finish flash update**

## Next actions

FPS-10 flash prommers must be updated using Phoenix!

## Updating FPS-10 flash prommer software

## Steps

1. Start *Phoenix Service Software* and log in, manage connection correctly for your flash prommer.
2. Choose **Flashing→Prommer maintenance** .
3. When the new flash update package is installed to the computer you will be asked to update the files to your Prommer. To update the files, click **Yes**. Click **OK** if the computer informs you about an unsafe removal of the device.
4. Alternatively you can update the FPS-10 flash prommer software by clicking the **Update** button.


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5. Wait until you are notified that update has been successful; the procedure will take a couple of minutes. Click **OK** to close the *Update Done* window.

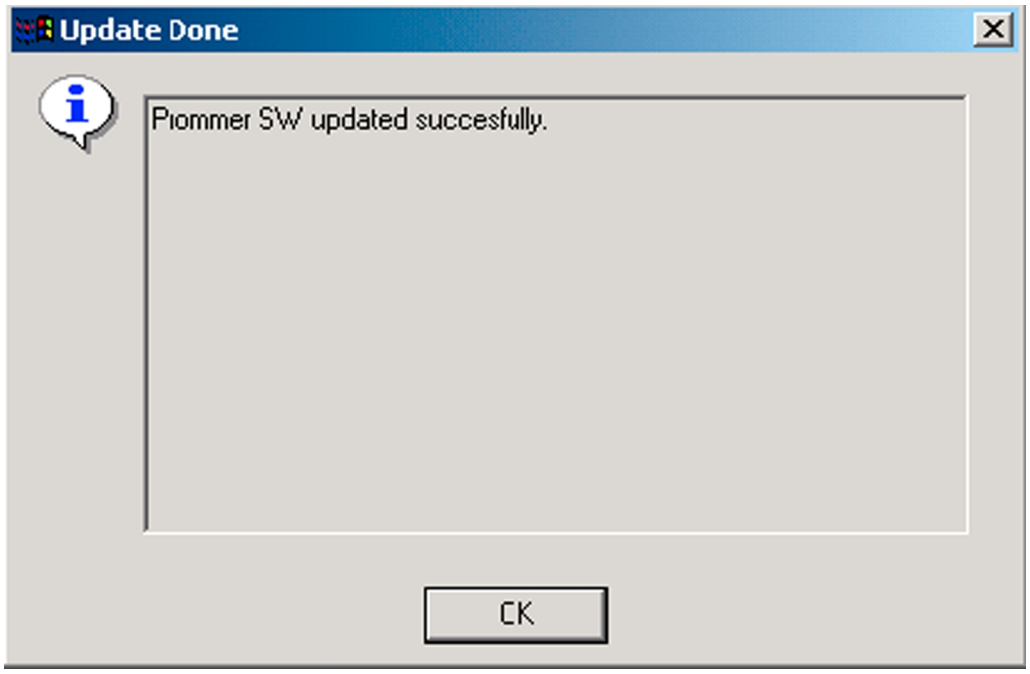


**Figure 32 Prommer SW update finished**

6. If you are using the FPS-10 flash prommer, check that it is detected from the progress info. Check also the status leds in the FPS-10. The MODE2 led (green), VBAT and POWER leds (red) should be lit. If you are using LAN connection, the LAN led (yellow) should be blinking.
7. Check that your FPS-10 flash prommer has enough memory. Flashing the SU-18 with FPS-10 needs at least 128 MB of SRAM memory in the prommer.

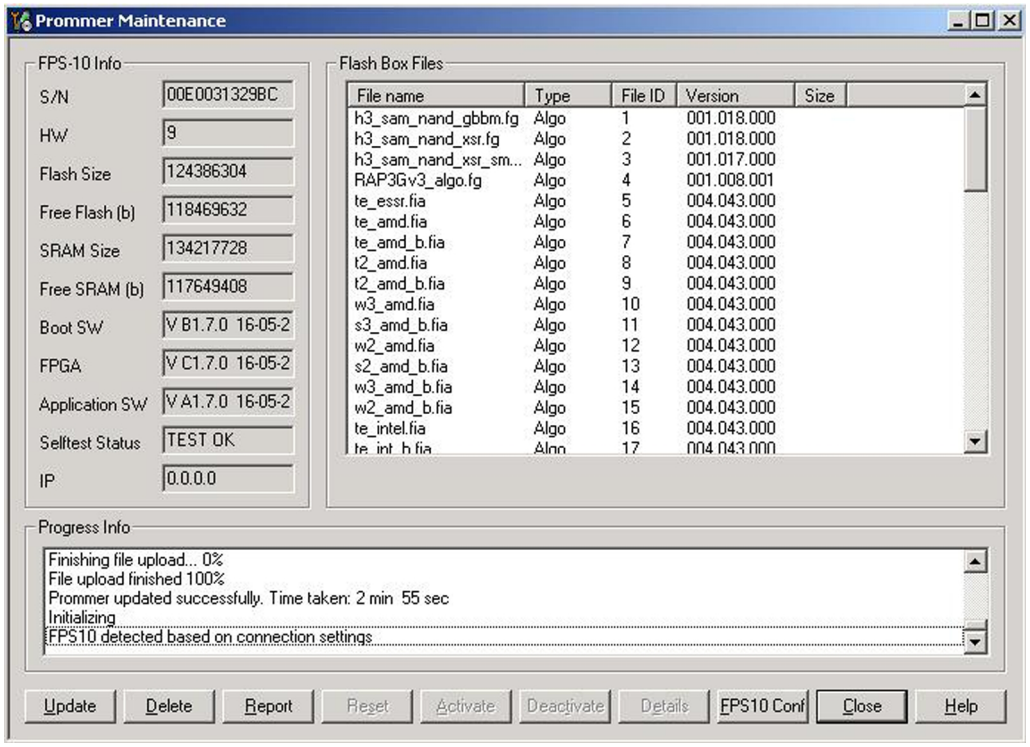


**Figure 33 Prommer maintenance window**


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## Alternative steps

- You can update FPS-10 SW by clicking the **Update** button and selecting the appropriate fpsxupd.ini file in *C:|Program Files|Nokia|Phoenix|Flash*.

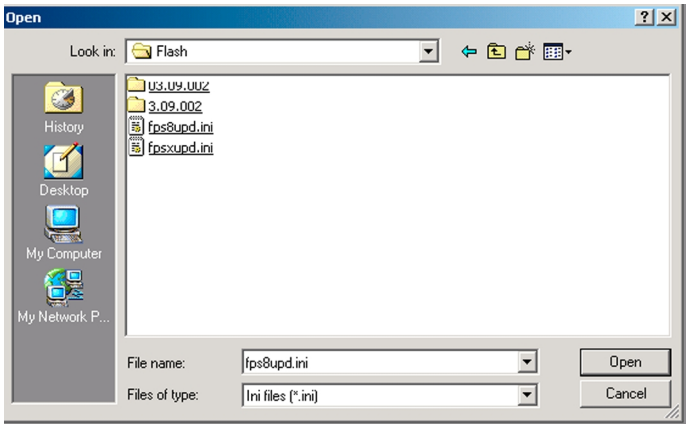


**Figure 34 Flash directory window**

- All files can be loaded separately to the prommer used. To do this, click the right mouse button in the *Flash box files* window and select the file type to be loaded.

  More information can be found in Phoenix **Help**.


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# 4 — Service Tools and Service Concepts


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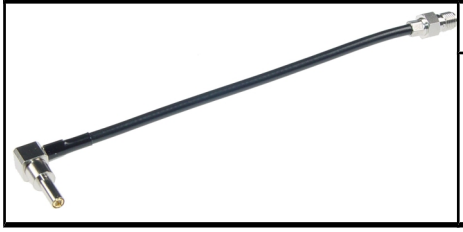
## Service tools

The table below gives a short overview of service tools that can be used for testing, error analysis and repair of product RM-100, refer to various concepts.

| | | | |
|---|---|---|---|
| | CA-31D | USB cable | |
| | The CA-31D USB cable is used to connect FPS-10 or FPS-11 to a PC. It is included in the FPS-10 and FPS-11 sales packages. | | |
| | CA-35S | Power cable | |
| | CA-35S is a power cable for connecting, for example, the FPS-10 flash prommer to the Point-Of-Sales (POS) flash adapter. | | |
| | CA-53 | USB connectivity cable | |
| | USB to system connector cable. | | |
|  | CA-58RS | RF probe | |
| | The RF Proble is used for galvanic RF measurements. | | |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| CU-4 | Control unit | |
|---|---|---|

CU-4 is a general service tool used with a module jig and/or a flash adapter. It requires an external 12 V power supply.

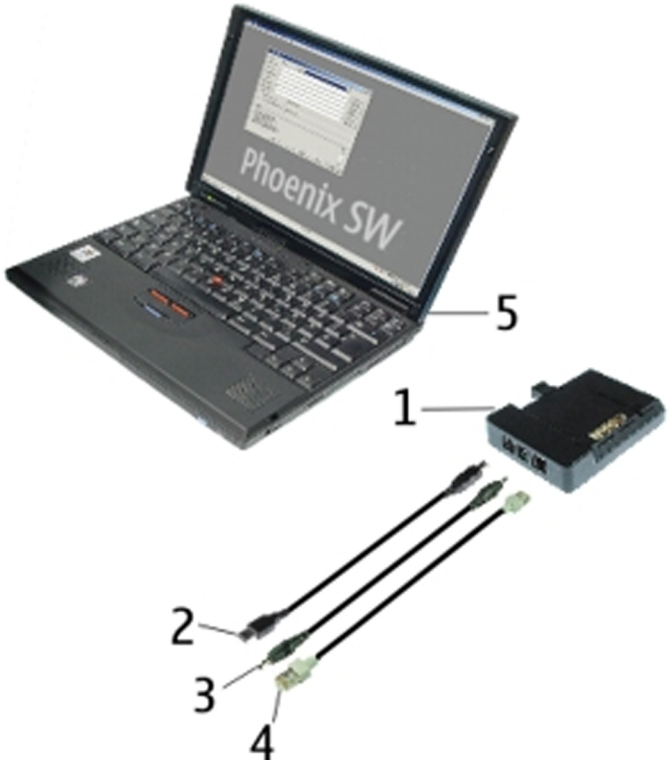
The unit has the following features:

- software controlled via USB
- EM calibration function
- Forwards FBUS/Flashbus traffic to/from terminal
- Forwards USB traffic to/from terminal
- software controlled BSI values
- regulated VBATT voltage
- 2 x USB2.0 connector (Hub)
- FBUS and USB connections supported

When using CU-4, note the special order of connecting cables and other service equipment:

## Instructions

1 Connect a service tool (jig, flash adapter) to CU-4.
2 Connect CU-4 to your PC with a USB cable.
3 Connect supply voltage (12 V)
4 Connect an FBUS cable (if necessary).
5 Start Phoenix service software.




**Note:** Phoenix enables CU-4 regulators via USB when it is started.

Reconnecting the power supply requires a Phoenix restart.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| FPS-10 | Flash prommer | |
|---|---|---|

FPS-10 interfaces with:

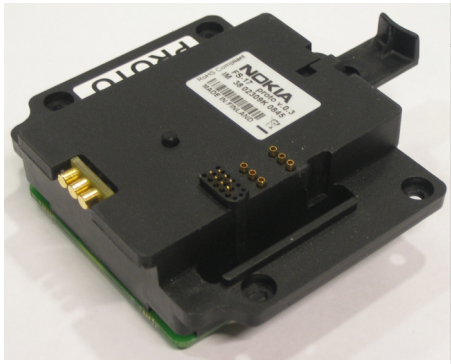
- PC
- Control unit
- Flash adapter
- Smart card

FPS-10 flash prommer features:

- Flash functionality for BB5 and DCT-4 terminals
- Smart Card reader for SX-2 or SX-4
- USB traffic forwarding
- USB to FBUS/Flashbus conversion
- LAN to FBUS/Flashbus and USB conversion
- Vusb output switchable by PC command

FPS-10 sales package includes:

- FPS-10 prommer
- Power Supply with 5 country specific cords
- USB cable



| FS-17 | Flash adapter | |
|---|---|---|

Flash adapter FS-17 is used for phone testing and flashing. FS-17 is used with the generic flash adapter base SS-60/62 and control unit CU-4 or interface adapter SS-46.

When flashing or system testing the phone, the adapter is attached to replace the phone own battery. All functions (as well as the calibration voltages, current and the protections for over voltages, over current and voltage polarity), are performed by CU-4.

Flash adapter FS-17 main features:

- VBATT supply interface
- USB / FBUS multiplexed interface to the phone
- Supply voltage for light source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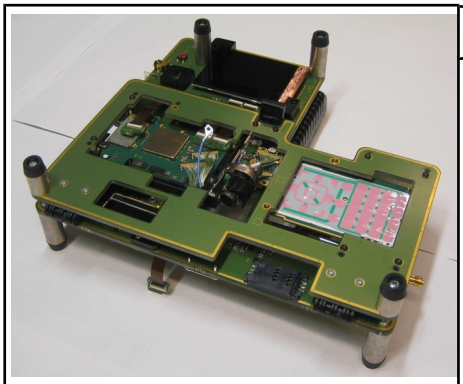

| MJ-75 | Module jig | |
|---|---|---|

MJ-75 is meant for component level troubleshooting. The jig includes an RF interface for WCDMA. For GSM, Bluetooth and NCW (WLAN) interfaces, it is possible to attach RF probe through a dedicated hole on MJ-75

The jig includes an RF interface for GSM, WCDMA, Bluetooth and NCW (WLAN). In addition, it has the following features:

- Provides galvanic connection to test pads
- Multiplexing between USB and FBUS media, controlled by Vusb
- MiniSD interface
- Audio components: 2x IHF, MIC, earpiece
- Connector for control unit
- Access for system connector
- **Table 9 Attenuation values**

| Channel | RX | TX |
|---|---|---|
| GSM900 | 0.2 | 0.2 |
| GSM1800 | 0.4 | 0.4 |
| GSM1900 | 0.4 | 0.4 |
| WCDMA2100 | 0.2 | 0.25 |

| PCS-1 | Power cable | |
|---|---|---|

The PCS-1 power cable (DC) is used with a docking station, a module jig or a control unit to supply a controlled operating voltage.

| PKD-1 | SW security device | |
|---|---|---|

SW security device is a piece of hardware enabling the use of the service software when connected to the parallel (LPT) port of the PC.

Without the device, it is not possible to use the service software.

Printer or any such device can be connected to the PC through the device if needed.


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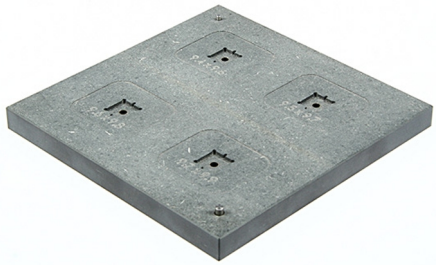
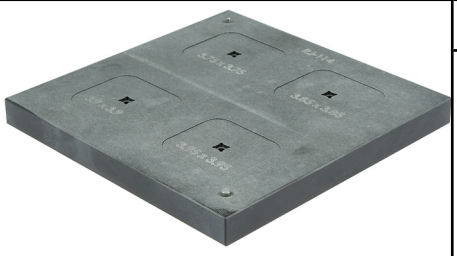
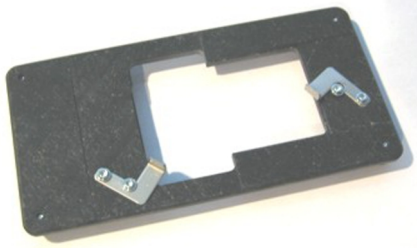
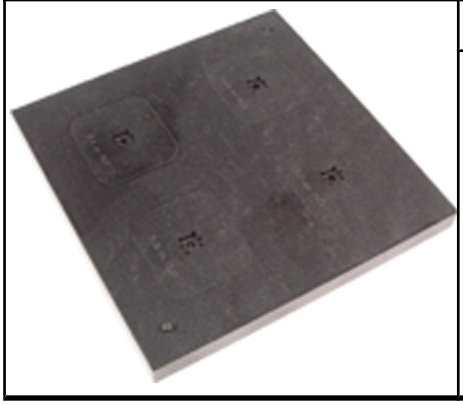
| | | | |
|---|---|---|---|
|  | RJ-103 | Rework jig | |
| | RJ-103 is a rework jig used with rework stencil ST-36. | | |
| | RJ-104 | Rework jig | |
| | RJ-104 is a rework jig used when servicing the BTHFM module. It is used together with rework stencil ST-37. | | |
|  | RJ-114 | Rework jig | |
| | RJ-114 is a rework jig used with ST-41. | | |
|  | RJ-143 | Soldering jig | |
| | RJ-143 is a soldering jig used for soldering and as a rework jig for the upper block PWB module (top part). | | |
|  | RJ-57 | Rework jig | |
| | RJ-57 is a rework jig used with ST-44. | | |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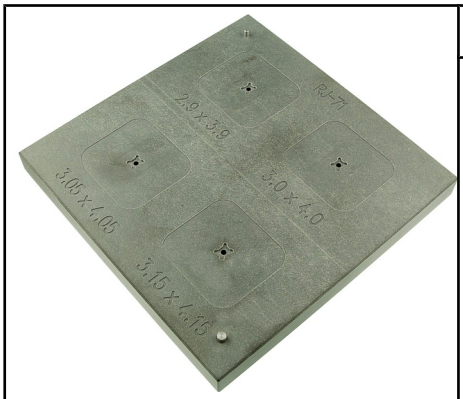
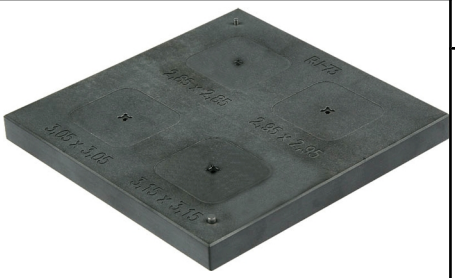
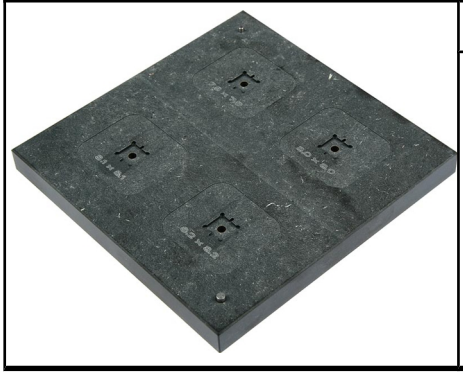
| | | | |
|---|---|---|---|
|  | RJ-71 | Rework jig | |
| | RJ-71 is a rework jig used with ST-26 rework stencil. | | |
|  | RJ-73 | Rework jig | |
| | RJ-73 is a rework jig used with ST-29. | | |
| | RJ-81 | Soldering jig | |
| | RJ-81 is a soldering jig used for soldering and as a rework jig for the engine module. | | |
|  | RJ-93 | Rework jig | |
| | RJ-93 is a rework jig used with ST-40. | | |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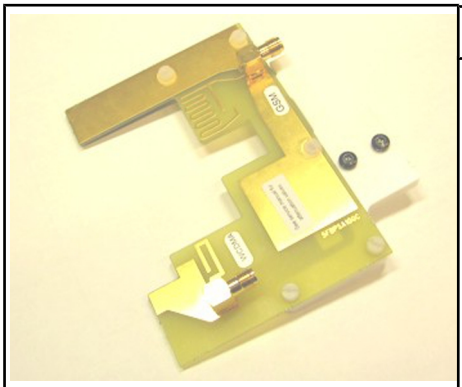

| SA-100 | RF coupler | |
|---|---|---|

SA-100 is an RF coupler for WCDMA and GSM RF testing. It is used together with the product-specific flash adapter.

The following table shows attenuations from the antenna pads of the mobile terminal to the SMA connectors of SA-100:

- **RF Coupler Loss**

| WCDMA Coupler | Channel | Coupler Loss |
|---|---|---|
| | | dB |
| WCDMA 2100 Band I TX | Low | 11.4 |
| | Mid | 10.4 |
| | High | 12.9 |
| WCDMA 2100 Band I Rx | Low | 10.5 |
| | Mid | 9.5 |
| | High | 10.5 |
| **GSM Coupler** | **Channel** | **Coupler Loss** |
| | | dB |
| GSM 900 Tx | Low | 7.8 |
| | Mid | 8.0 |
| | High | 8.3 |
| GSM 900 Rx | Low | 8.1 |
| | Mid | 7.7 |
| | High | 8.0 |
| GSM 1800 Tx | Low | 8.4 |
| | Mid | 9.1 |
| | High | 9.9 |
| GSM 1800 Rx | Low | 7.9 |
| | Mid | 8.6 |
| | High | 9.4 |
| GSM 1900 Tx | Low | 8.4 |
| | Mid | 8.5 |
| | High | 8.9 |
| GSM 1900 Rx | Low | 9.4 |
| | Mid | 8.0 |
| | High | 8.4 |


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| | | | |
|---|---|---|---|
| | SB-6 | Bluetooth tester | |
| | The SB-6 test box is a generic device to perform Bluetooth bit error rate testing and doing cordless FBUS connection via Bluetooth. | | |
| | SB-7 | WLAN test box | |
| | WLAN test requires defined position for the device. | | |
| | SPS-2 | Soldering paste spreader | |
| | | | |
| | SRT-6 | Opening tool | |
| | SRT-6 is used to open phone covers and B-to-B connectors. | | |


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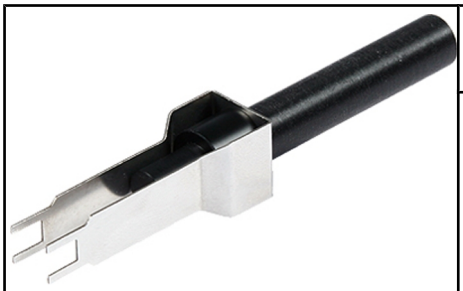
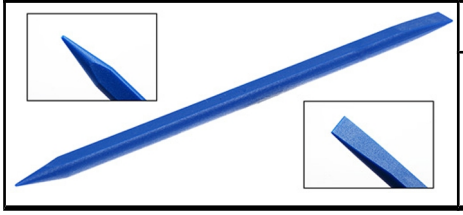
| | | | |
|---|---|---|---|
|  | SS-45 | Front camera removal tool | |
| | The front camera removal tool SS-45 is used to remove/attach the front camera module from/to the socket. | | |
| | SS-46 | Interface adapter | |
| | SS-46 acts as an interface adapter between the flash adapter and FPS-10. | | |
| | SS-62 | Generic flash adapter base for BB5 | |
| | • generic base for flash adapters and couplers<br>• SS-62 equipped with a clip interlock system<br>• provides standardised interface towards Control Unit<br>• provides RF connection using galvanic connector or coupler<br>• multiplexing between USB and FBUS media, controlled by VUSB | | |
| | SS-82 | Domesheet alignment tool | |
| | SS-82 is an alignment tool used for keymat alignment. | | |
|  | SS-93 | Opening tool | |
| | SS-93 is used for opening JAE connectors. | | |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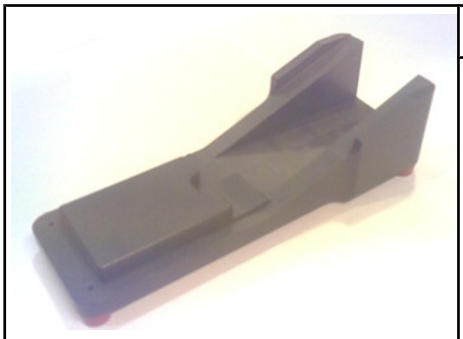
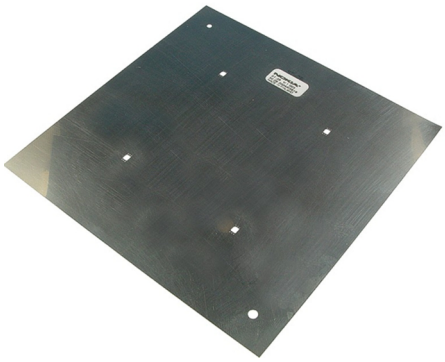
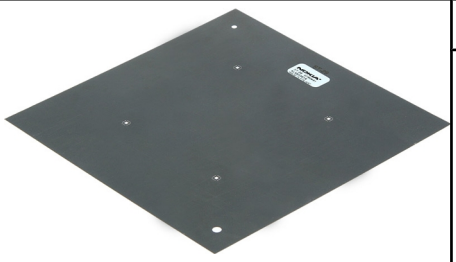
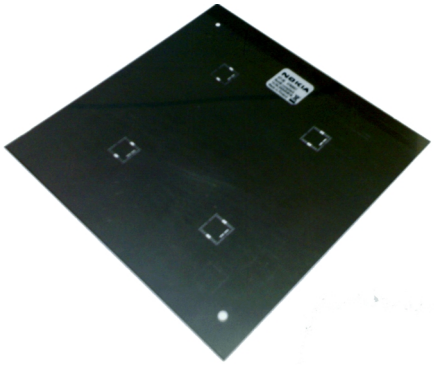
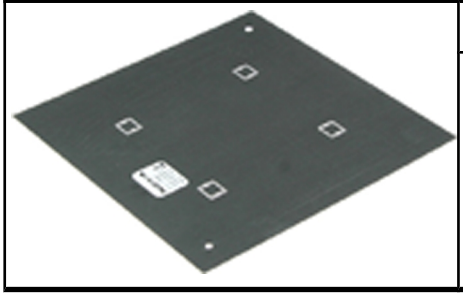
| | | | |
|---|---|---|---|
|  | SS-95 | Hinge assembly jig | |
| | SS-95 is used for assembling top and bottom part together. | | |
|  | ST-26 | Rework stencil | |
| | ST-26 is a rework stencil used with rework jig RJ-71. | | |
|  | ST-29 | rework stencil | |
| | This stencil is to be used together with RJ-73. | | |
|  | ST-36 | Rework stencil | |
| | ST-36 is a rework stencil used with rework jig RJ-103. | | |
|  | ST-37 | BTHFM rework stencil | |
| | ST-37 stencil is used with RJ-104 BTHFM rework jig. | | |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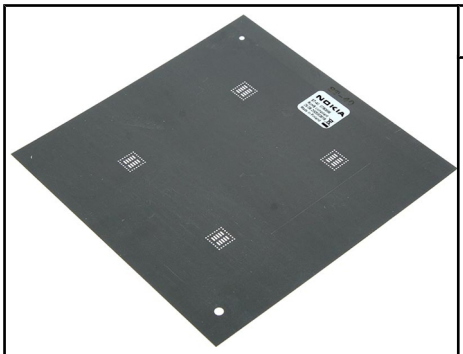
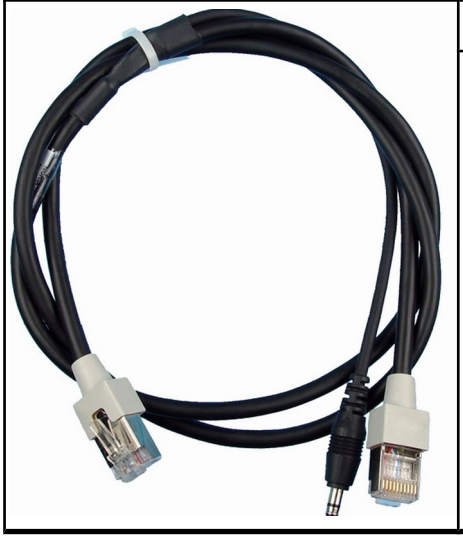
| | | | |
|---|---|---|---|
|  | ST-40 | rework stencil | |
| | ST-40 is a rework stencil and used with RJ-93. | | |
| | ST-41 | Rework stencil | |
| | ST-41 is a rework stencil used with rework jig RJ-114. | | |
| | ST-44 | Rework stencil | |
| | ST-44 is a rework stencil used with rework jig RJ-57. | | |
| | SX-4 | Smart card | |
| | SX-4 is a BB5 security device used to protect critical features in tuning and testing.<br>SX-4 is also needed together with FPS-10 when DCT-4 phones are flashed. | | |
|  | XCS-1 | Service cable | |
| | The XCS-1 service cable is used to connect FLS-4S to the POS flash adapter for supplying a controlled operating voltage and data connection. | | |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| | | | |
|---|---|---|---|
| | XCS-4 | Modular cable | |
| | XCS-4 is a shielded (one specially shielded conductor) modular cable for flashing and service purposes. | | |
| | XRS-6 | RF cable | |
| | The RF cable is used to connect, for example, a module repair jig to the RF measurement equipment.<br>SMA to N-Connector approximately 610 mm.<br>Attenuation for:<br>• GSM850/900: 0.3+-0.1 dB<br>• GSM1800/1900: 0.5+-0.1 dB<br>• WLAN: 0.6+-0.1dB | | |


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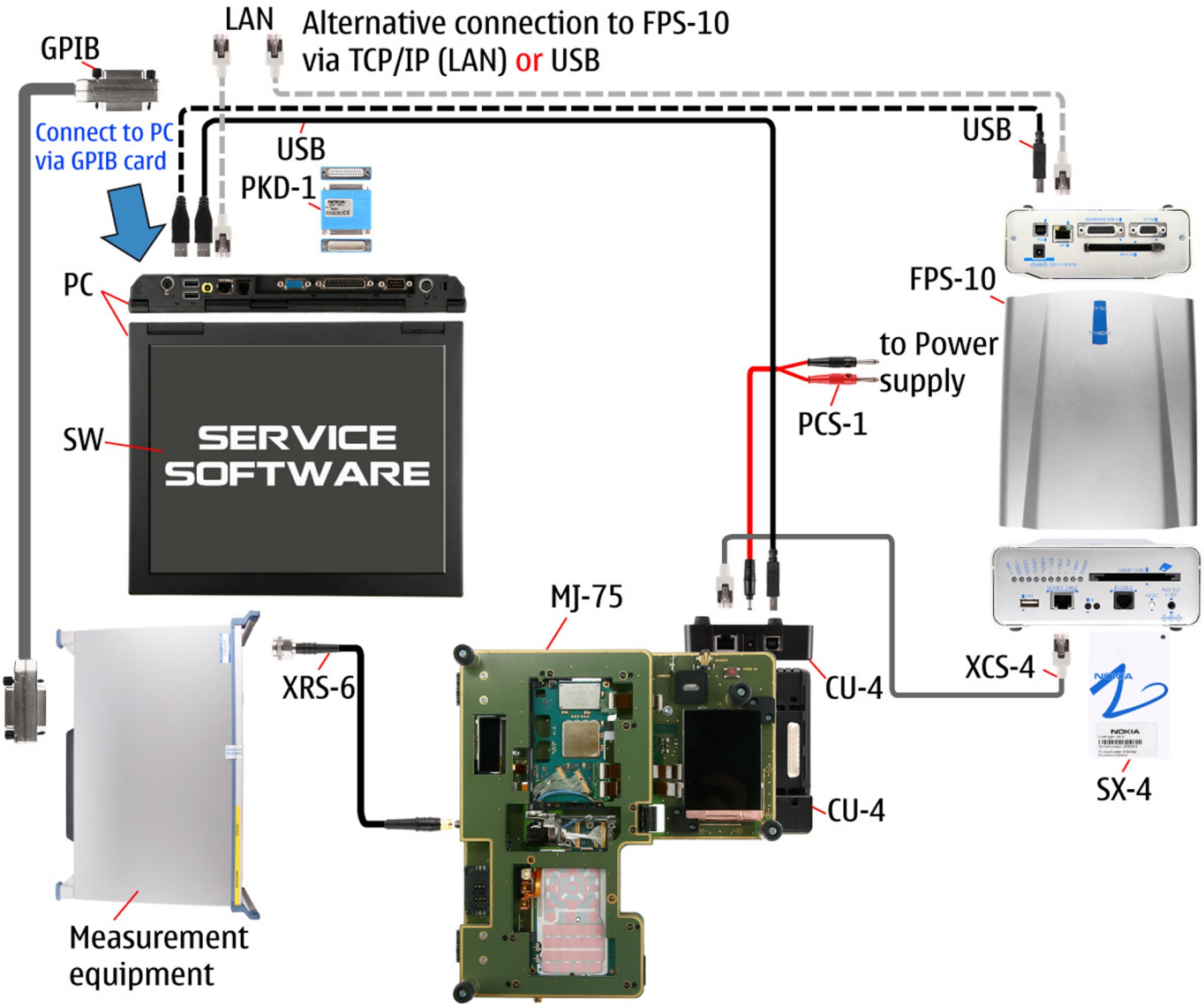
## Service concepts

### Flash concept with MJ-75, CU-4, FPS-10 and SX-4





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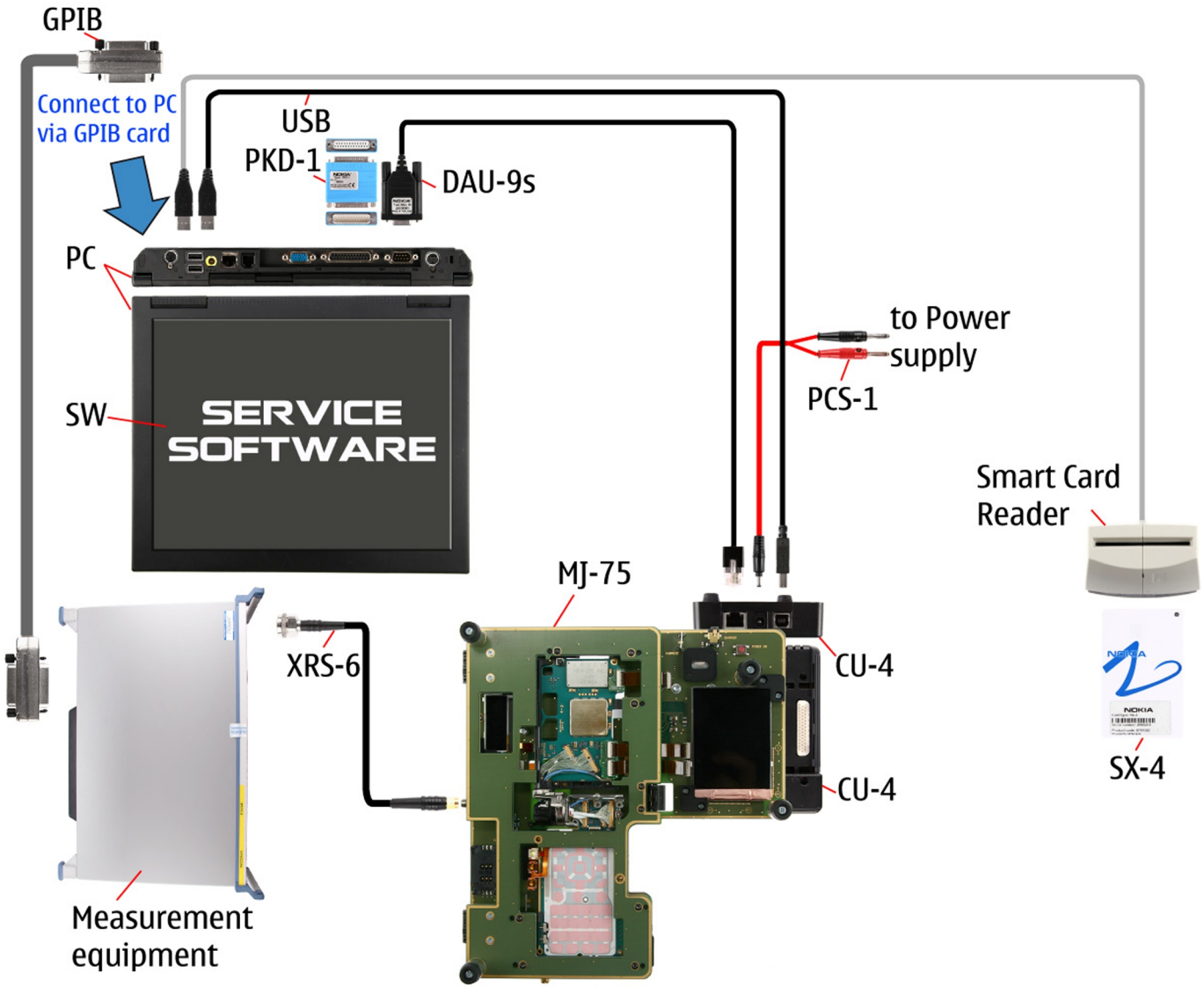
## Flash concept with MJ-75, CU-4, smart card reader and SX-4





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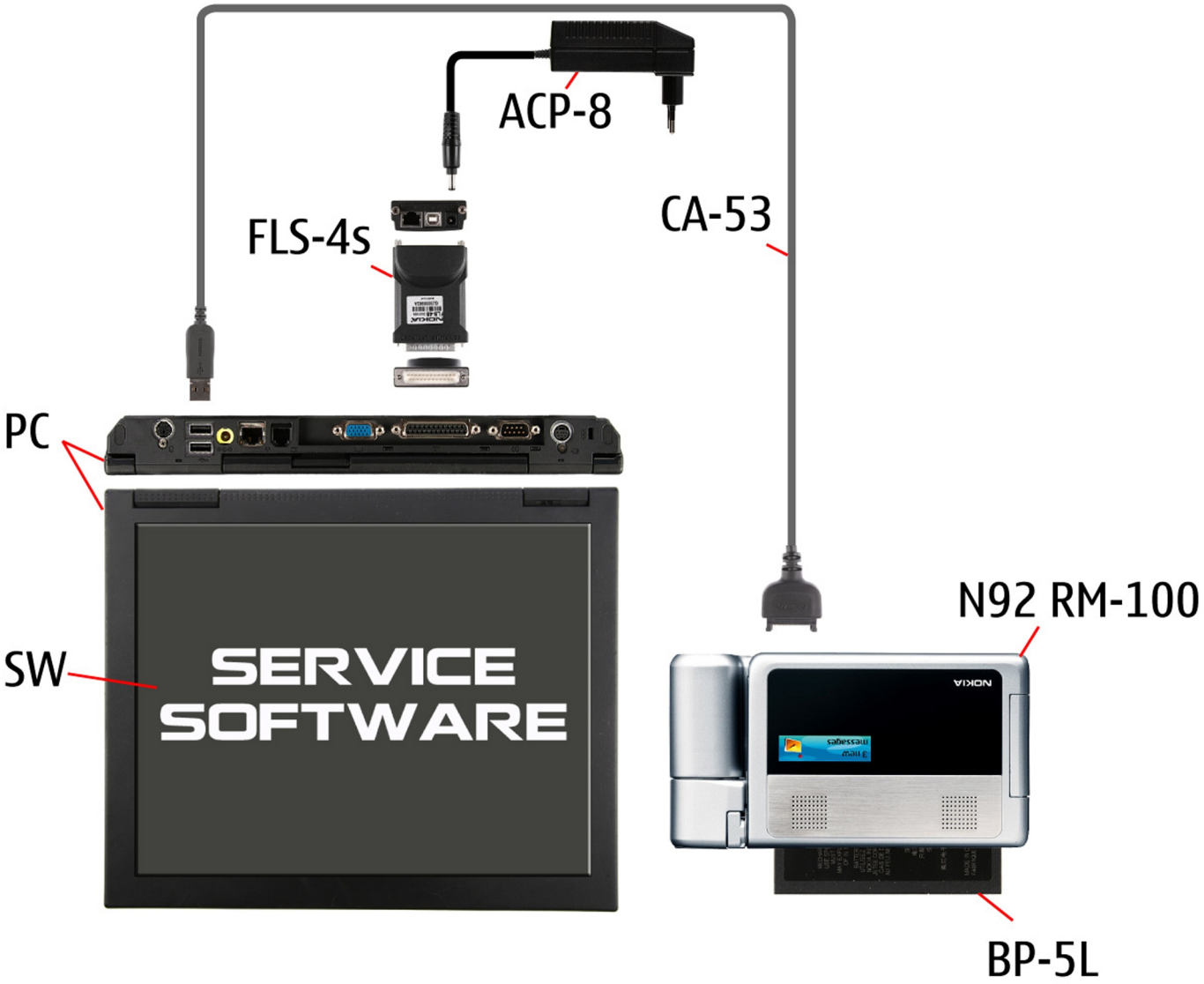
## POS flash concept





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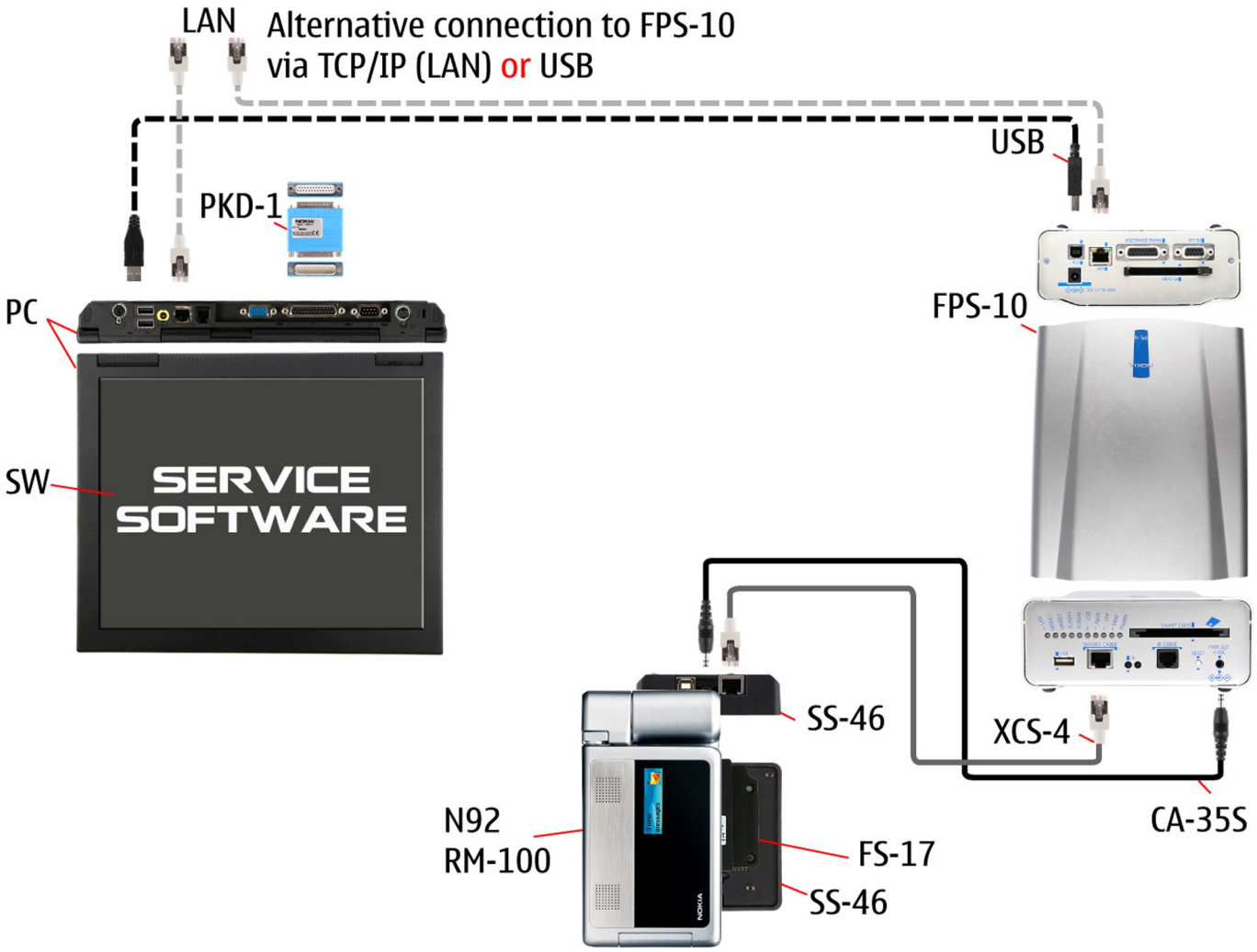
## Flash concept with SS-46, FS-17 and FPS-10





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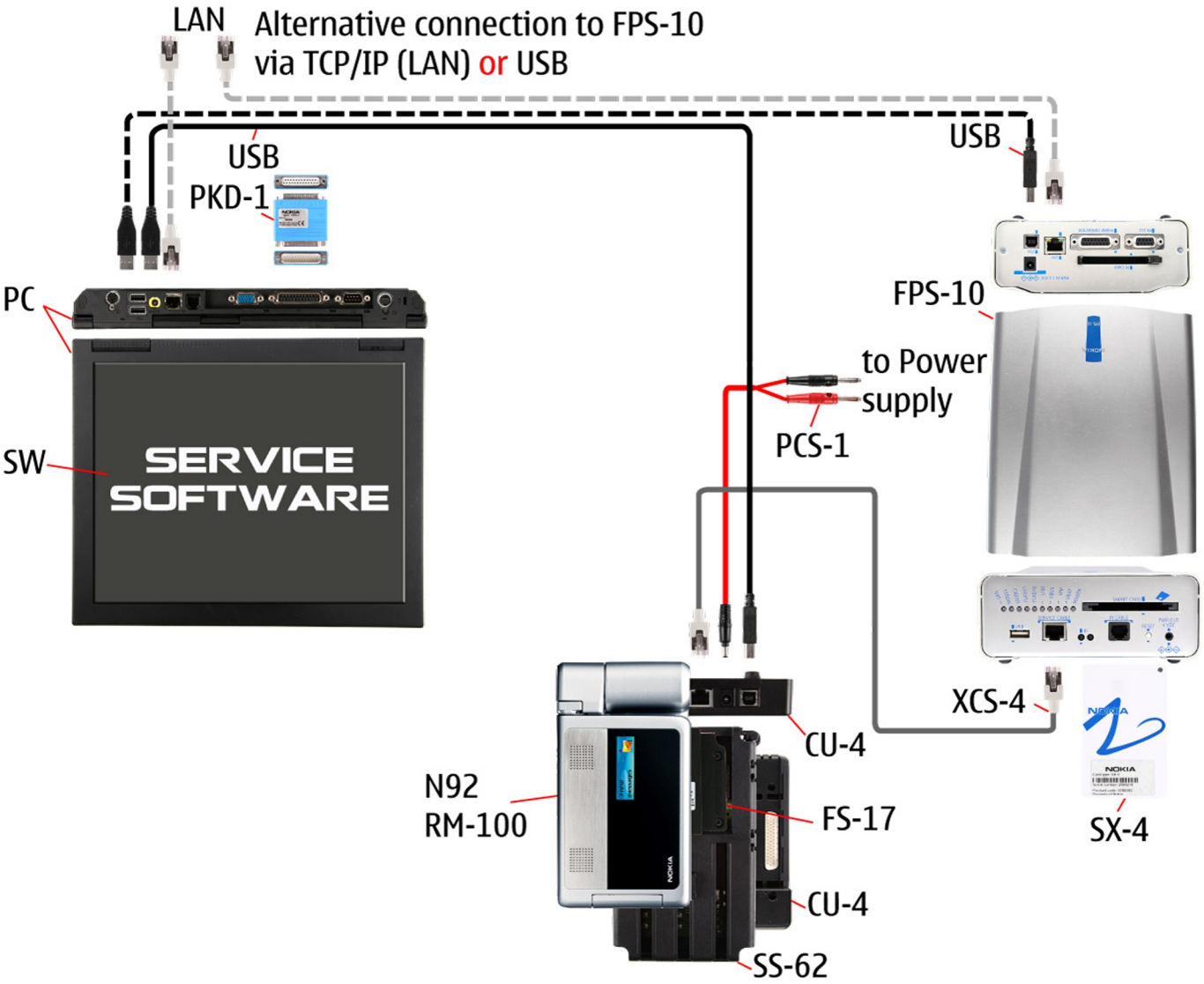
## Flash concept with SS-62, FS-17, CU-4 and FPS-10





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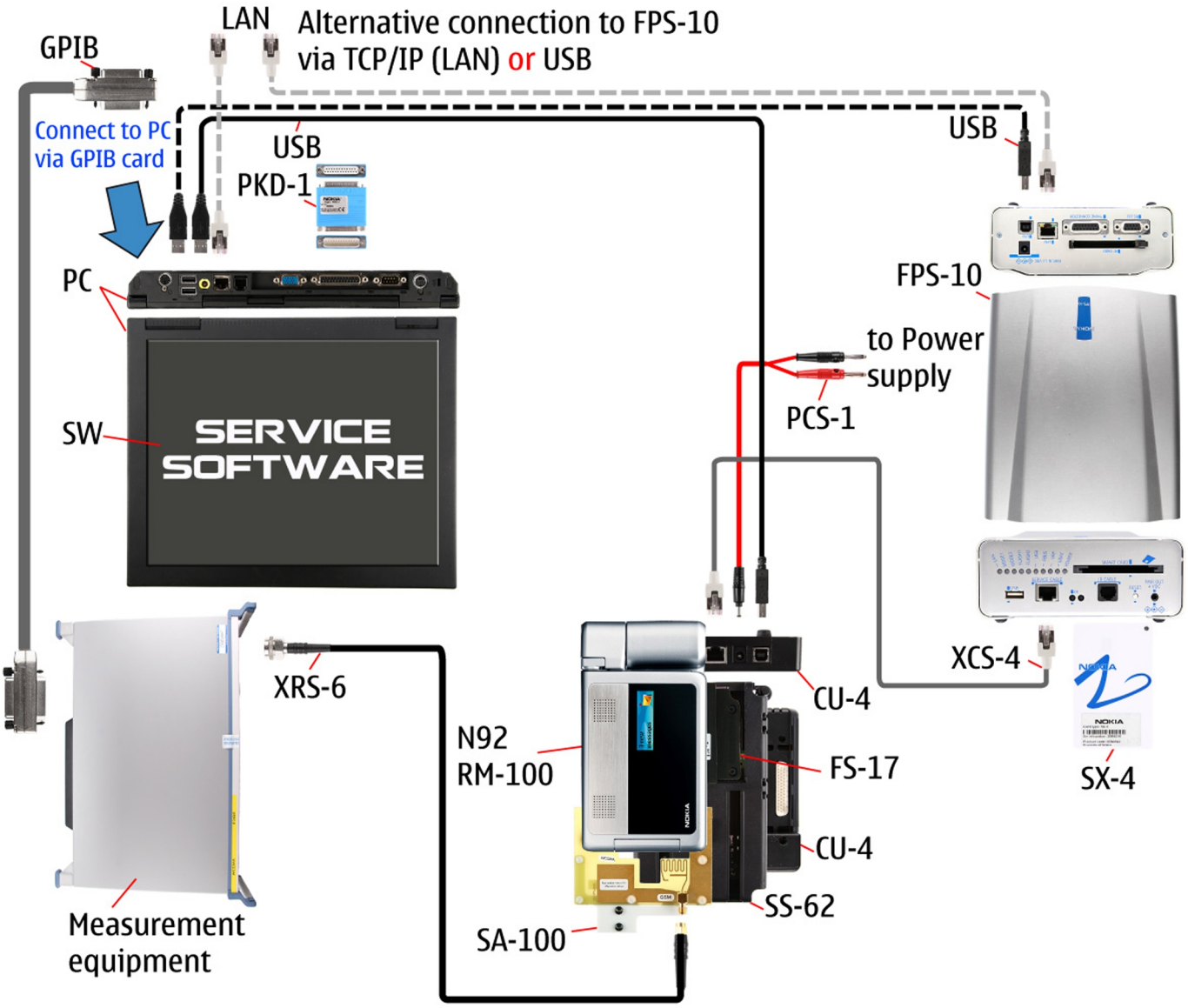
## Flash concept with SS-62, FS-17, CU-4, smart card reader and SX-4





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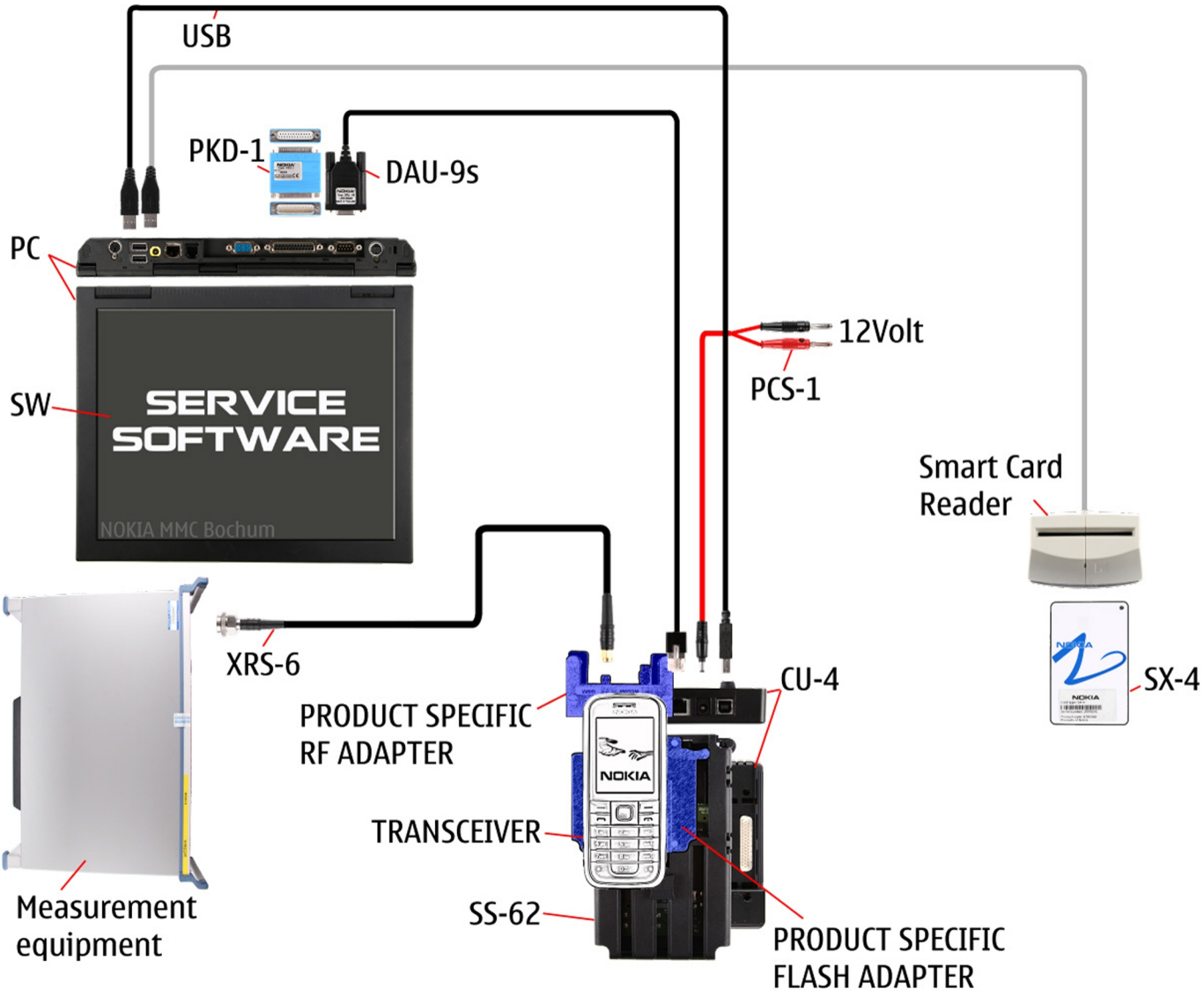
## DVB-H RX testing concept with SS-62, FS-17, SA-100, smart card reader and SX-4





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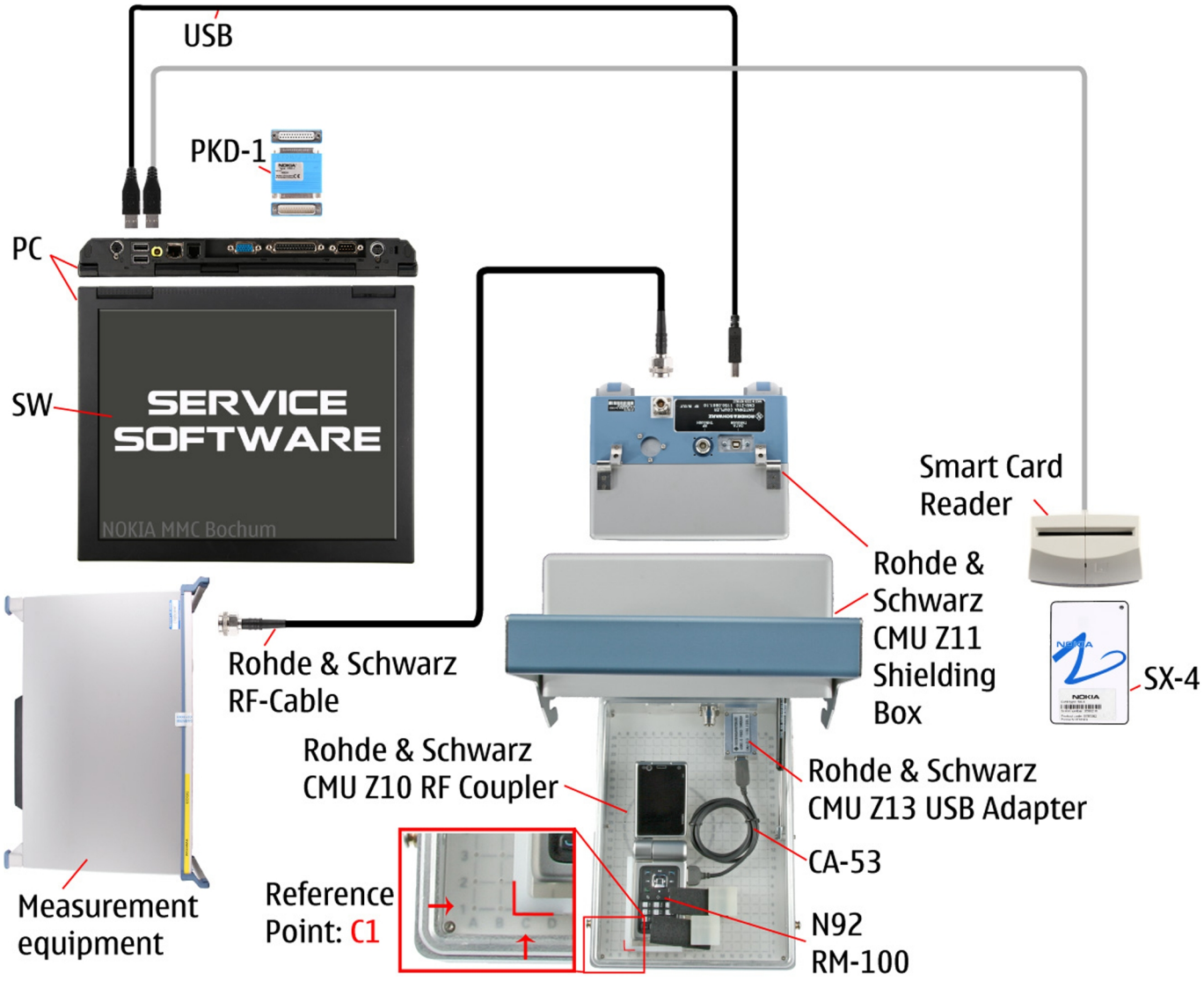
## DVB-H tuning and RX testing concept with Rohde & Schwarz shielding box + RF coupler, smart card reader and SX-4





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# 5 — Disassembly/Reassembly Instructions


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## Disassembly and reassembly instructions

**Note:** Reassembly takes place in the reverse order.


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## UPPER BLOCK DISASSEMBLY

1. Needed tools: The SRT-6, the SS-93, metal tweezers, dental pick, a torque driver with a Torx plus size 6 bit, the SS-45 camera removal tool, and a Torx plus driver size 6.

2. Cover all windows with a protective film.

3. Ensure that no battery is inserted before going on.

4. Release the clips of the **Hinge Cover A** from the top side first.

5. Now release the clips of the **Hinge Cover B.**

6. Bring the assembly into position shown and remove the **Hinge Cover.**


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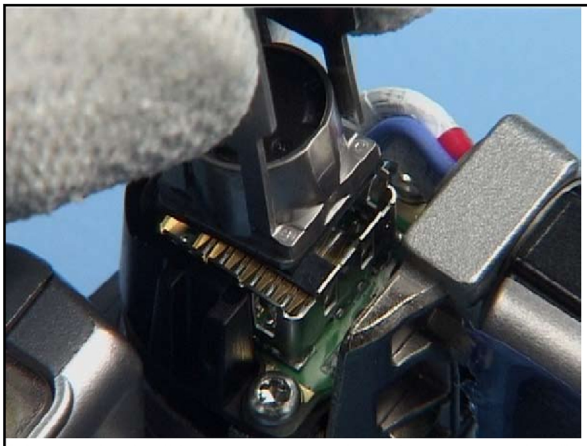
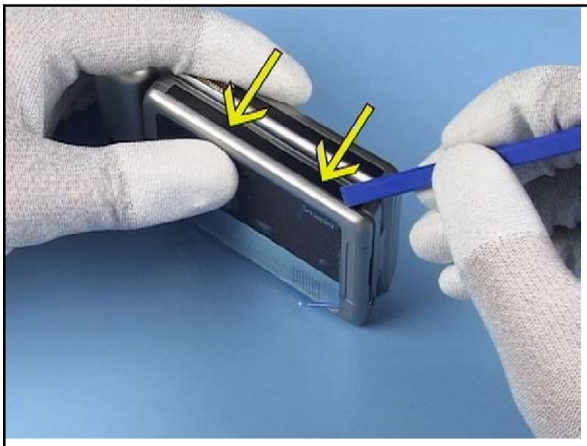
7. Carefully release the clip of the **Hinge Cover B** ...

8. ... and remove it.

9. Remove the **Camera Window Elastomer**.



10. Use the SS-45 camera removal tool to release the **Camera Module 2Mpix** as shown.



11. Carefully remove the two plastic clips of the **A-Cover** with the SS-93.

12. Release both clips on the hinge side too. Note that these clips are very delicate.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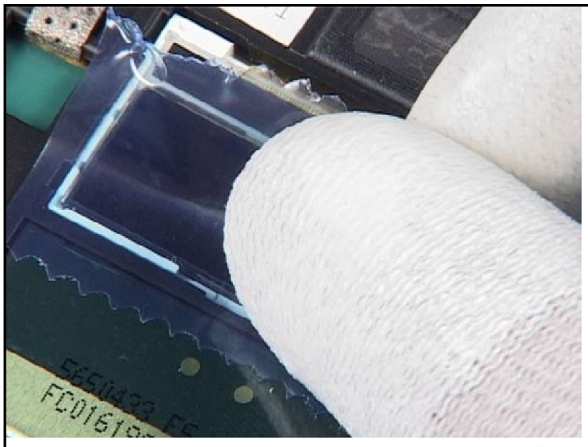
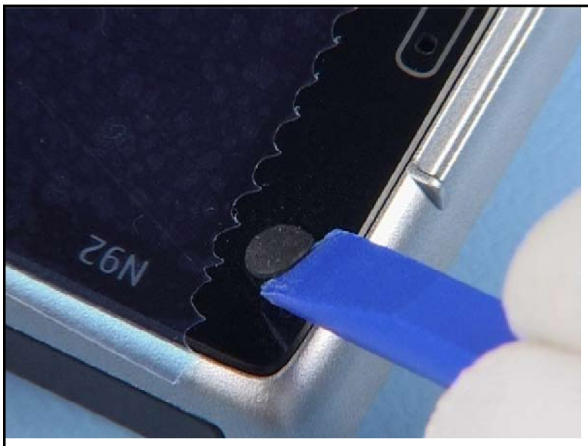
13. Use the SS-45 camera removal tool to release the **Camera Module 2Mpix** as shown.



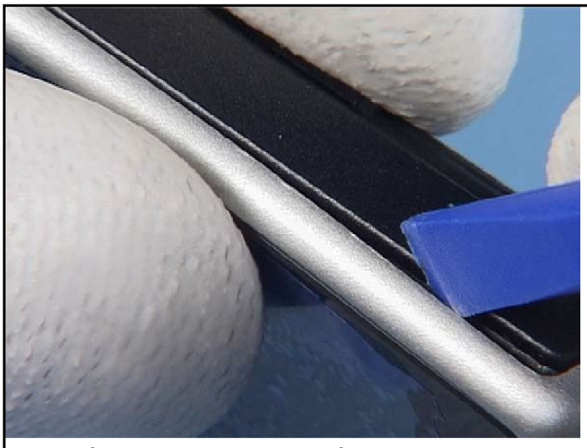
14. Cover the 2nd Display Module with a protective film.




15. Prevent scratching the window while removing the **Bumper Plugs**.

16. Undo both screws and discard them.

17. Do not use them again.



18. Carefully release the snaps of the **B-Cover Assy**.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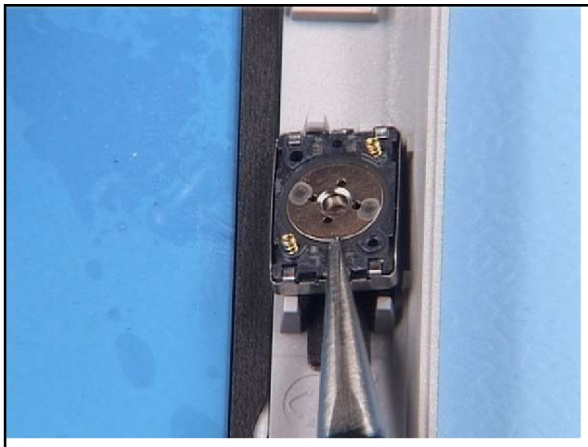
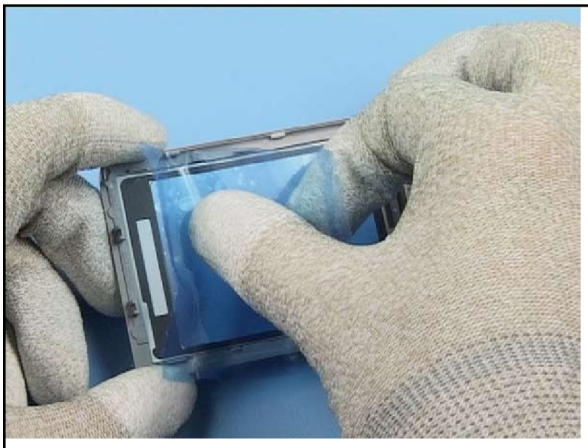
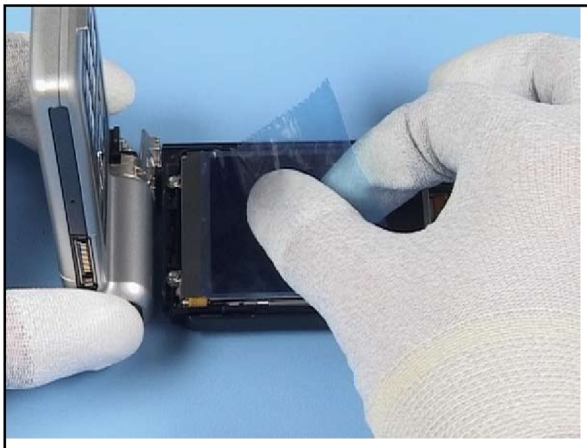
19. Lift up the **B-Cover Assy** carefully and release all clips.



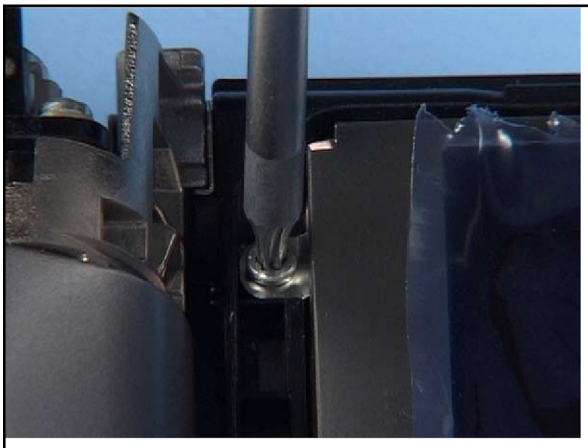
20. Remove the **Earpiece**.



21. Cover the inner side window with a plastic film.



22. Cover the display with a protective film, too.



23. Undo both screws and discard them.

24. Do not use these screws again.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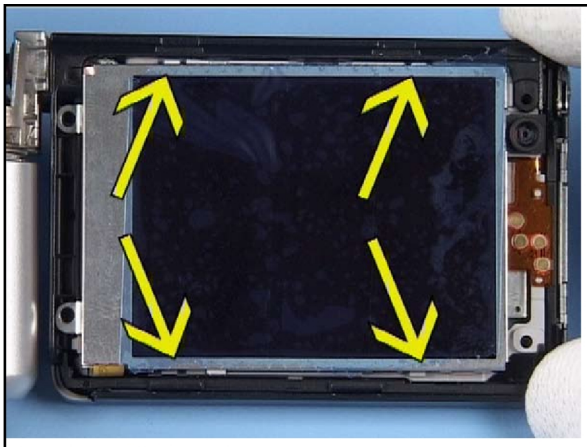
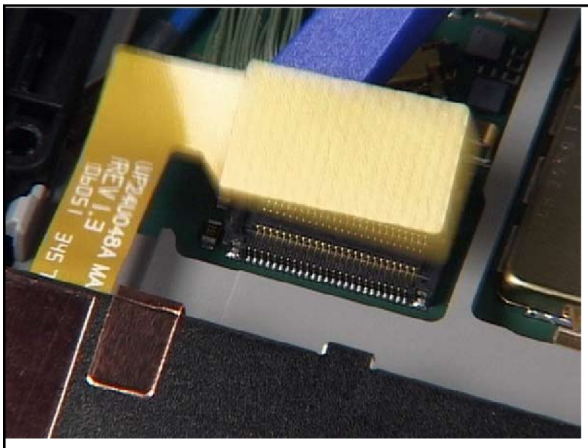
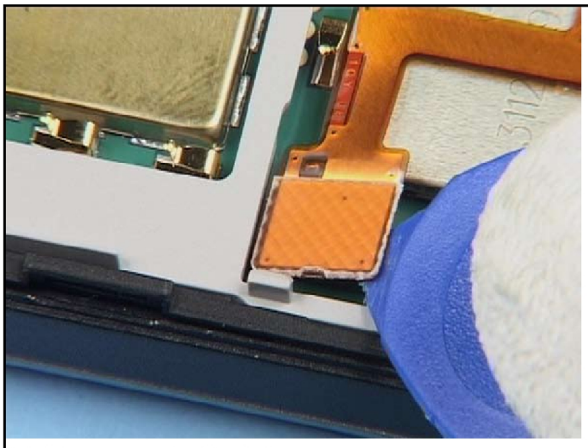
25. Carefully release and remove the clips of the **Display Frame Assy**.



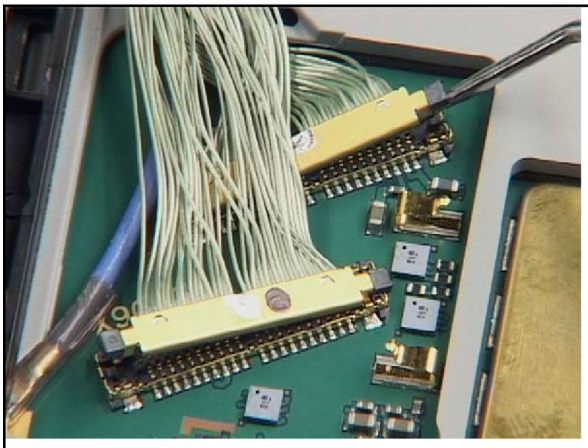
26. Release all these 4 snaps.



27. Open the connector with the SS-93.



28. Disconnect the flex foil connector.



29. Carefully release the coax connector in the order shown.

30. Remove them completely with the SS-93.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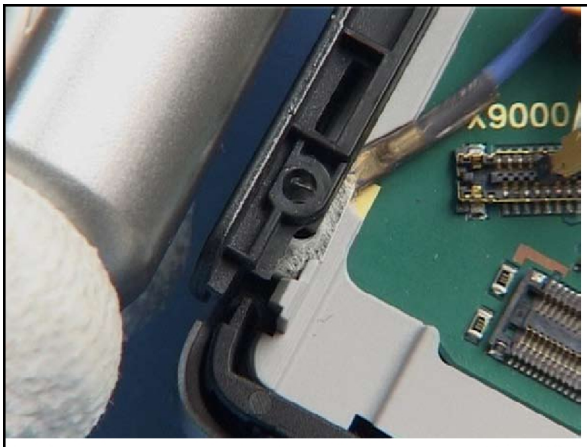
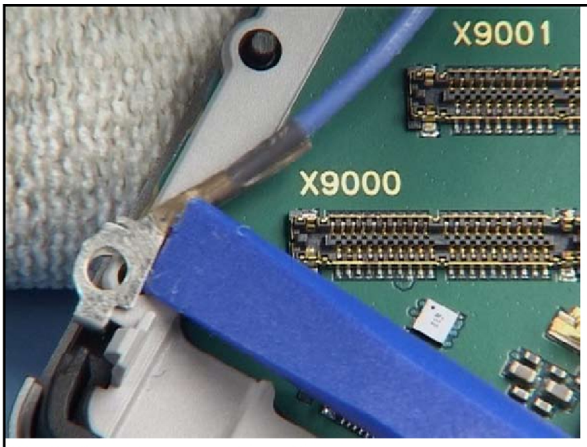
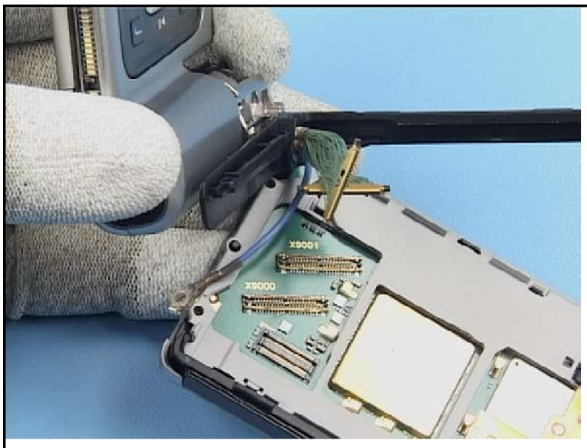


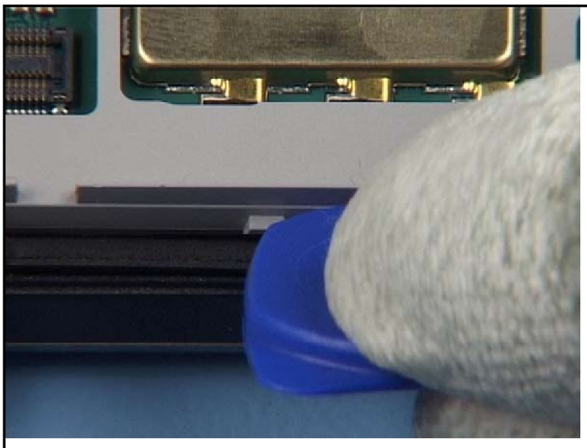

31. Release the snaps and separate the assemblies. Note that the grounding cable is still connected.




32. Shift up the grounding clip.

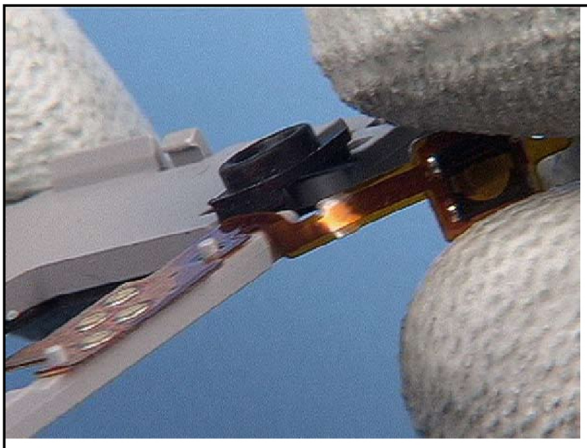


33. Now, the parts can be separated completely.



34. Release the snap as shown.

35. Now the **Spacer Frame Assy** can be removed.



36. Carefully release the glued in **1QY Top FPC Assy**.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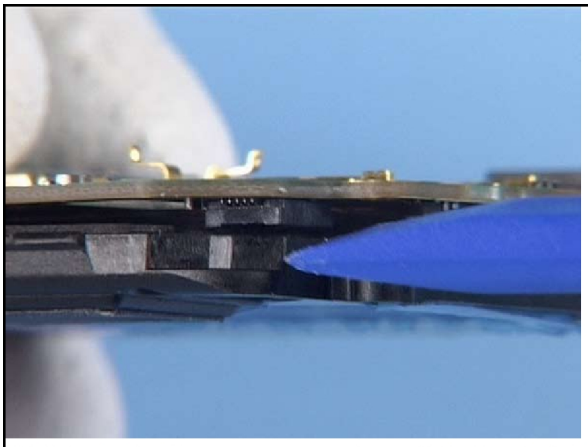
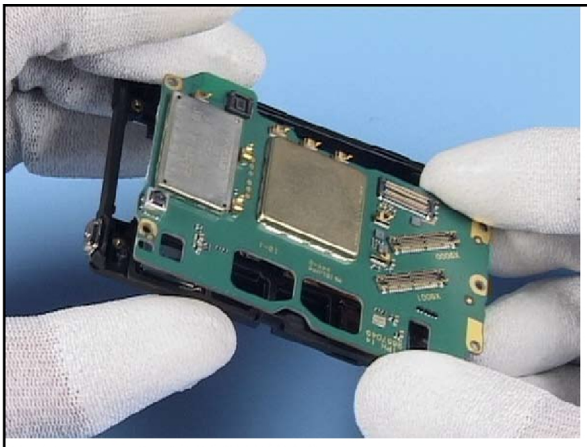
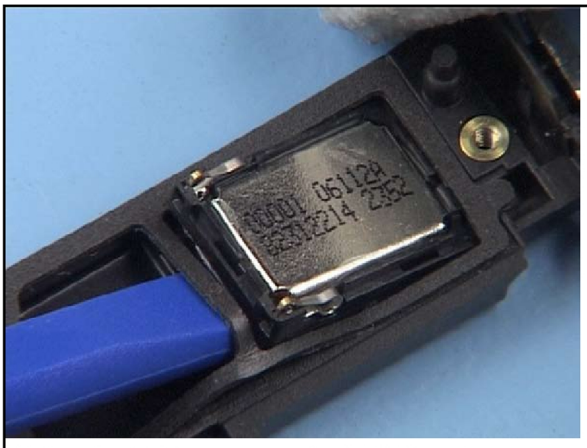


37. Release the flex connector of the 2nd Display Module with the SS-93.



38. Remove the **DVB-H PWB Assy**.

39. Remove the 2nd Display Module.



40. Use the SS-93 to ease out both **IHF Speakers**.

41. Always use a new **IHF Adhesive** when reassemble.

42. The disassembly procedure of the upper block is now complete.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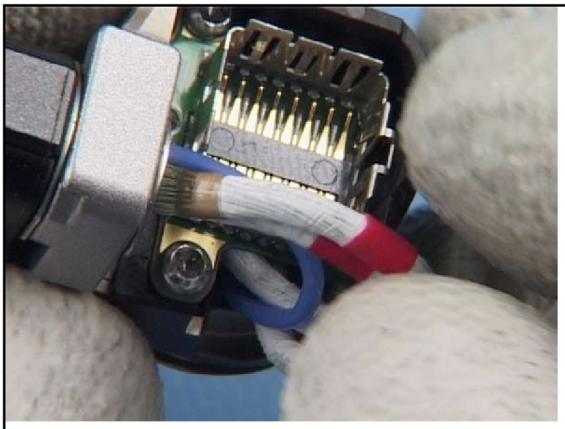
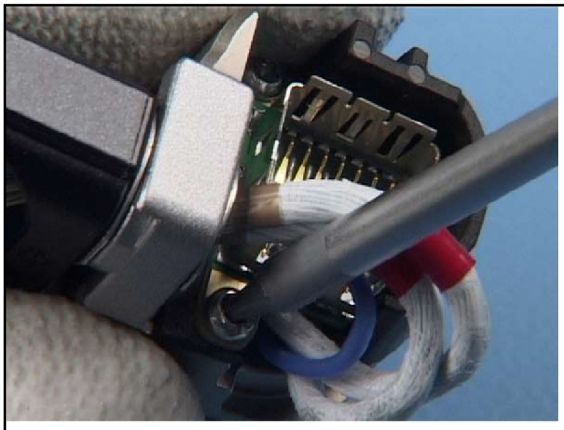
## UPPER BLOCK - HINGE MODULE DISASSEMBLY

1. The procedure to disassemble the **Hinge Module Assy** is shown here. The disassembly of the lower block was already done.

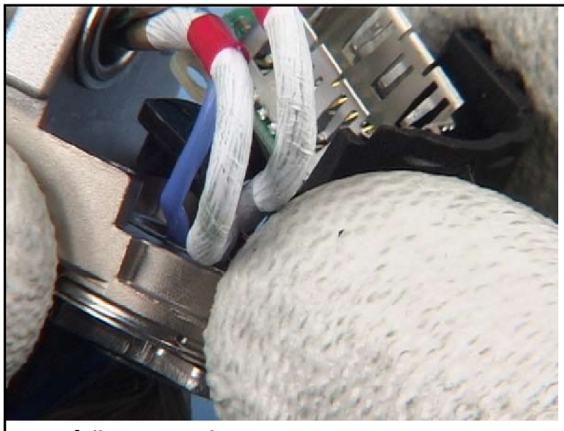


2. Carefully pull out the cables to achieve the screws.

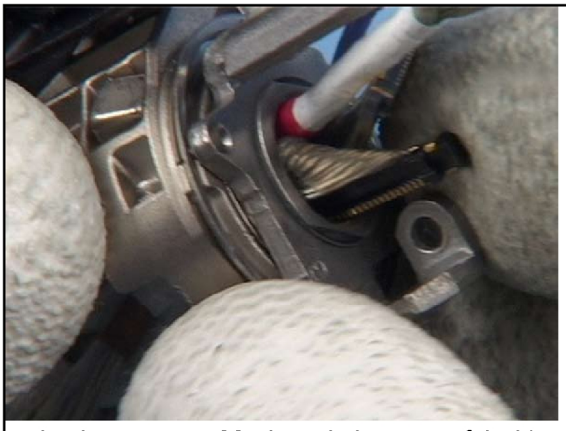


3. Undo both screws and discard them.

4. Do not use them again.



5. Carefully remove the **Camera Support**.



6. Slot the **Camera Cable** through the recess of the hinge.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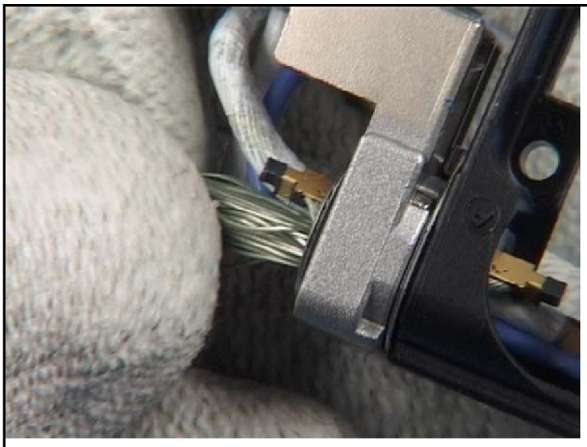
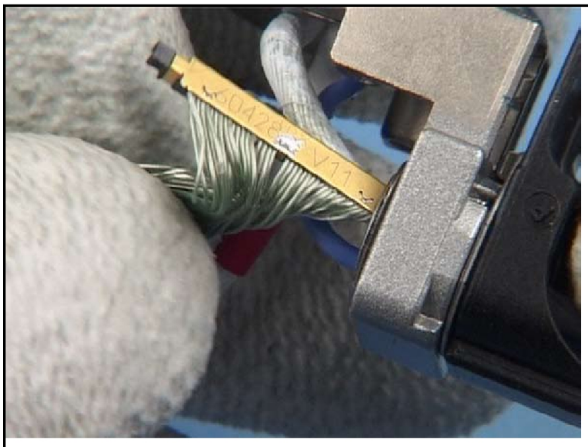
7. Carefully twist the connector of the **Coax Cable**. Now pull the cable while slotting the connectors through the recess of the **Hinge Module Assy**.

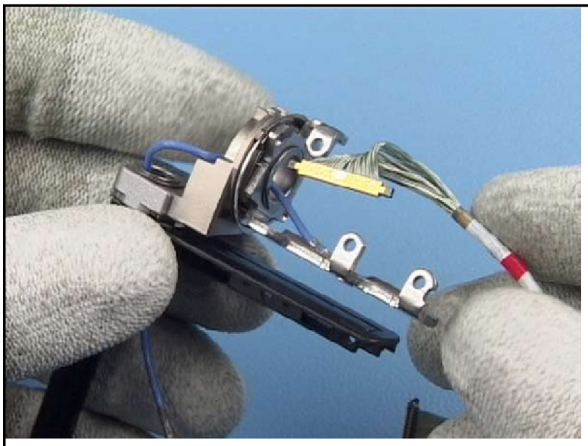


8. Note that the cables are not squeezed during this procedure.

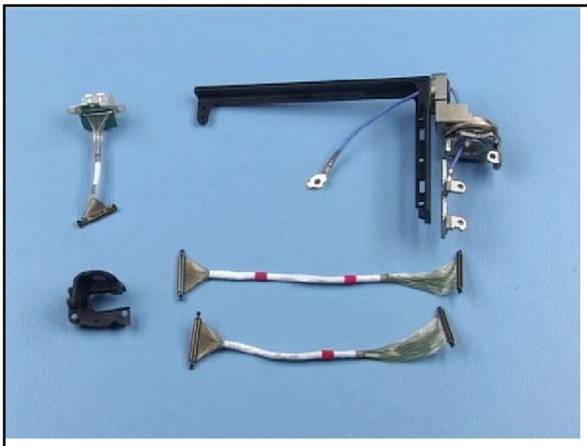


9. Do the same with the second **Coax Cable**.

10. Carefully twist the connector of the **Coax Cable**. Now pull the cable while slotting the connectors through the second recess of the **Hinge Module Assy**.



11. Do the same with the second **Coax Cable**.



12. Now the disassembly of the Hinge assy is completed.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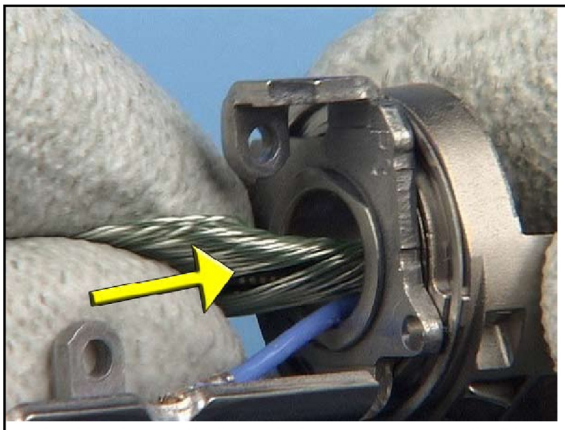
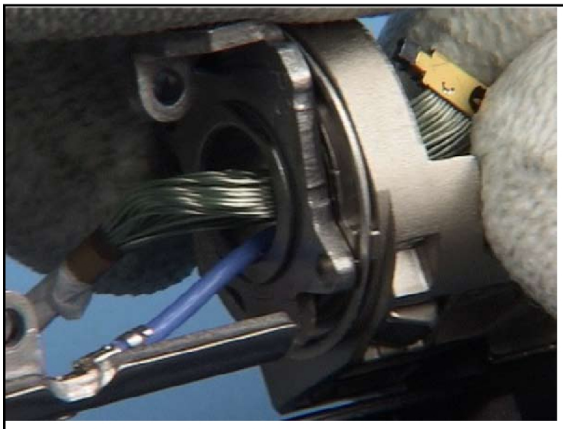
## UPPER BLOCK - HINGE MODULE ASSEMBLY

1. **Hinge Module Assy** assembly.

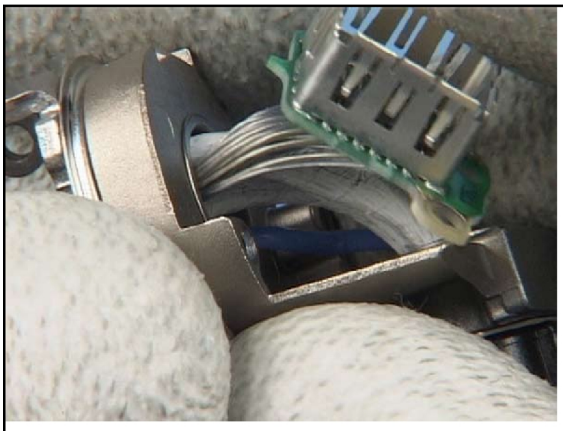


2. Slot the first cable through both recesses of the hinge in direction shown.

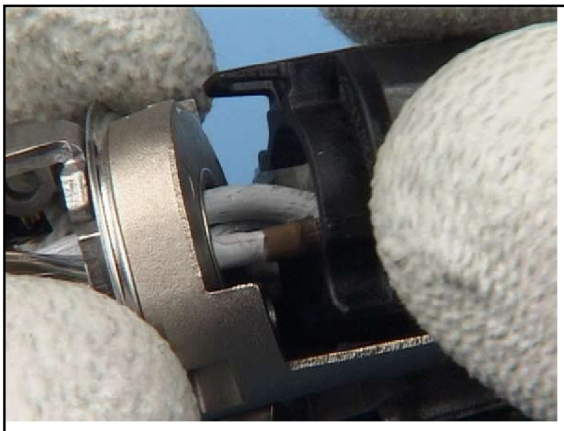


3. Do not squeeze the cables.

4. Do the same with the second **Coax Cable**.



5. Place the **Camera Cable Assy** into its compartment.



6. Insert the **Camera Support**.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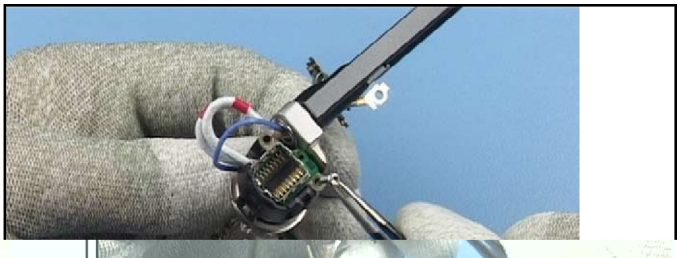
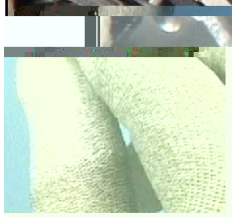
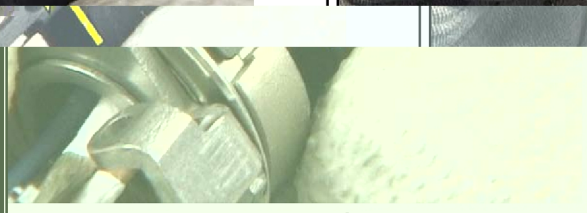
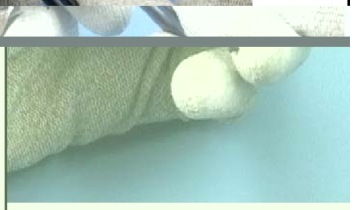




tioned as shown.

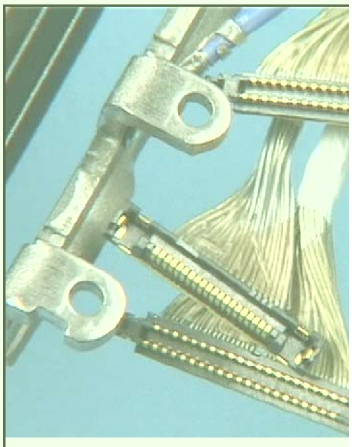


7. Note the correct positioning of the alignment tab.

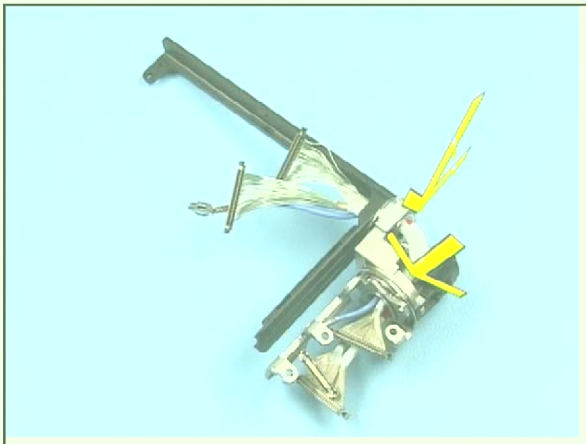


8. Insert two new screws.

9. Tighten the screws with the correct torque.



10. Ensure that the cables are pos



11. Red marks on the **Coax Cables** must be visible.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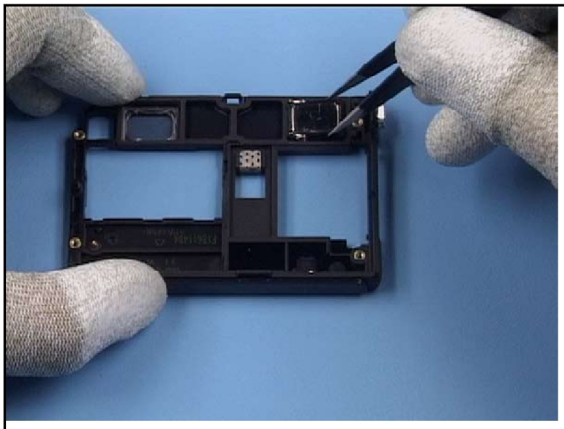
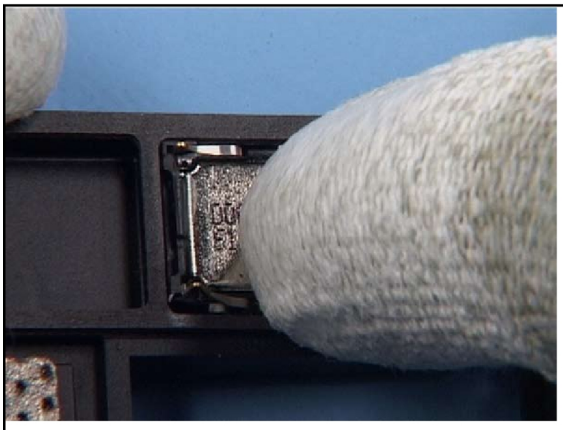
## UPPER BLOCK ASSEMBLY

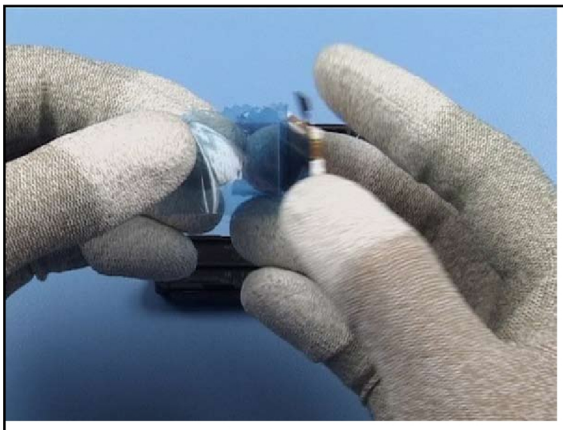
1. Upper Block Assembly



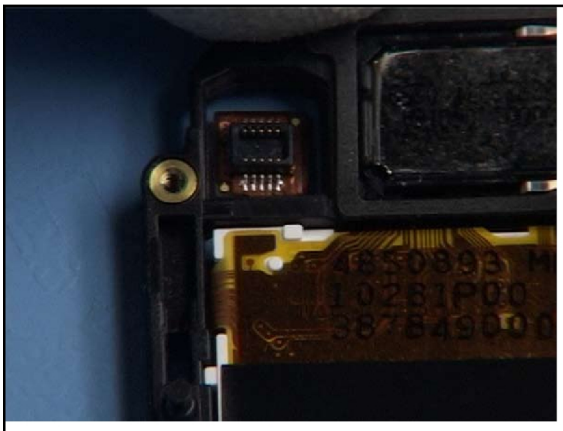
2. Place the **IHF Speaker** into their compartments. Mind that new **IHF Adhesives** are fitted.



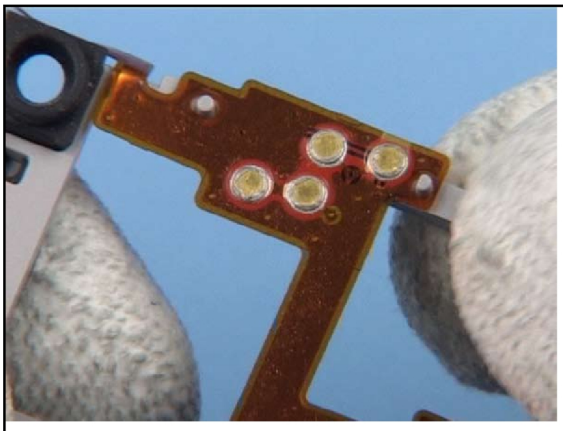
3. Push the **IHF Speakers** into their places, do not touch the spring contacts.



4. Remove the plastic film from the 2nd Display Module.



5. Position the display as shown.



6. Position the **1QY Top FPC Assy** to the **Spacer Frame** and smooth it down slightly, note the guide pins.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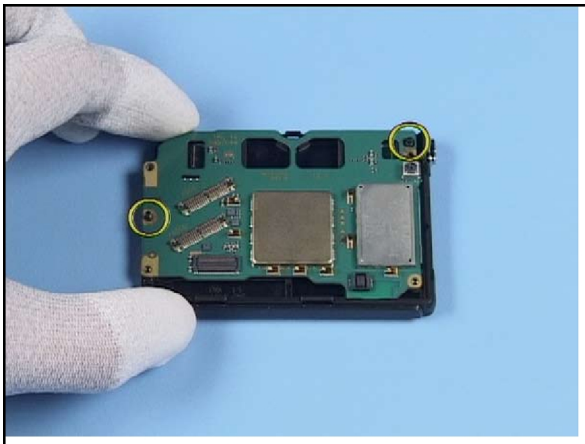
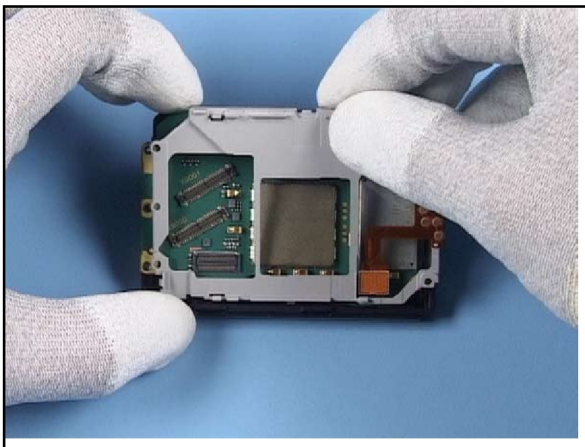
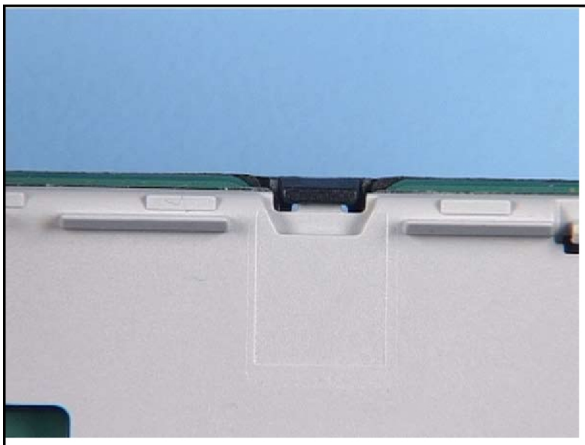


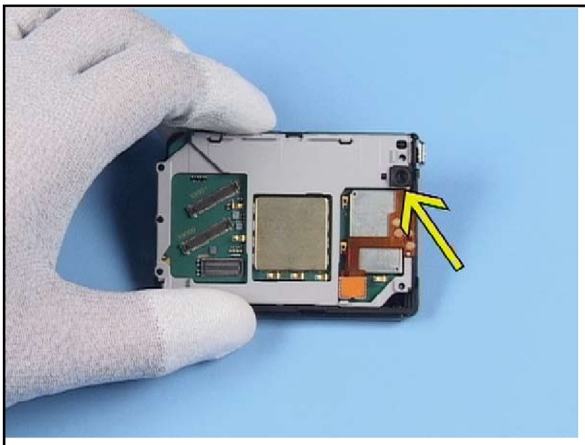
7. Position the **DVB-H PWB Assy**, mind the guiding pins.



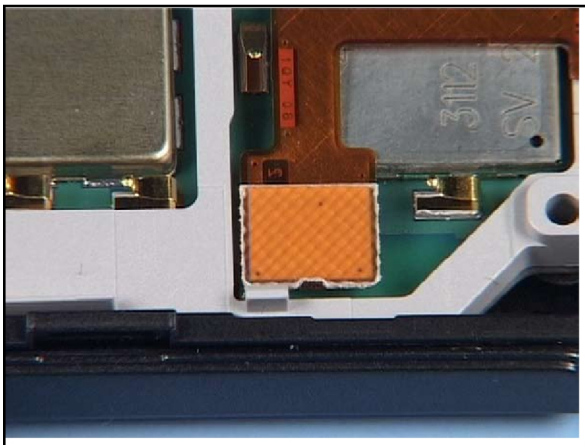
8. Now place the **Spacer Frame Assy**.



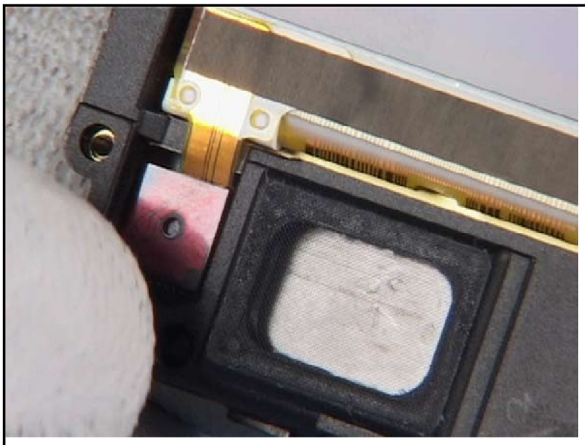
9. Mind that all snaps are clicked into their places.



10. Check the correct positioning of the **Camera Elastomer** before going on.



11. Close the connector.



12. Turn the assembly and close the display connector.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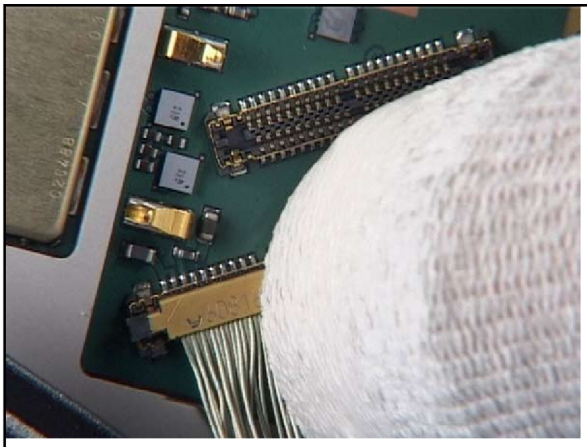
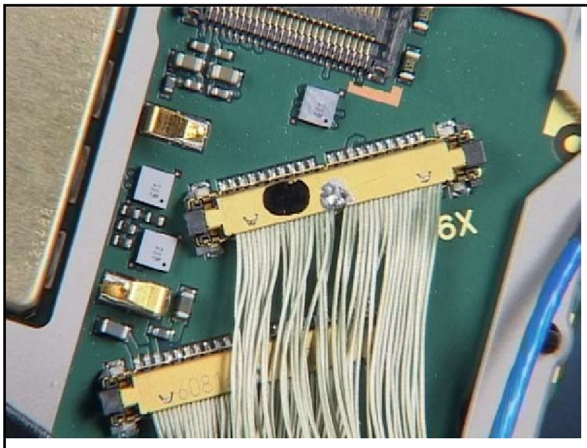
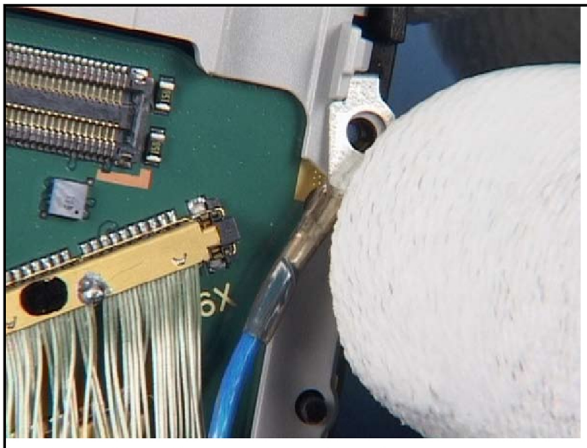
13. Cover the display with a protective film.



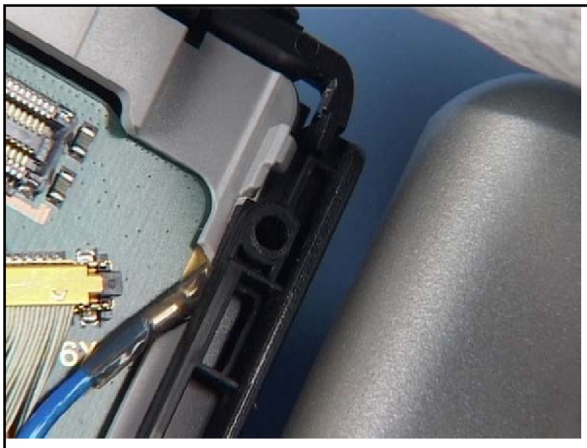
14. Close the connector of the shorter **Coax Cable** first.



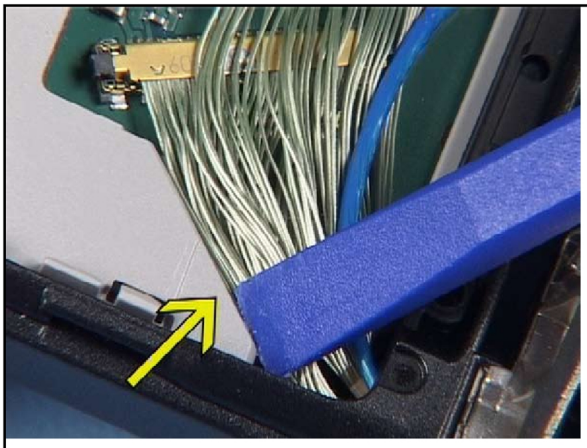

15. Now close the second connector, too.




16. At least position the grounding clip as shown.



17. Click the snaps of the assembly into their places.



18. Ensure that all cables are correctly positioned before continuing.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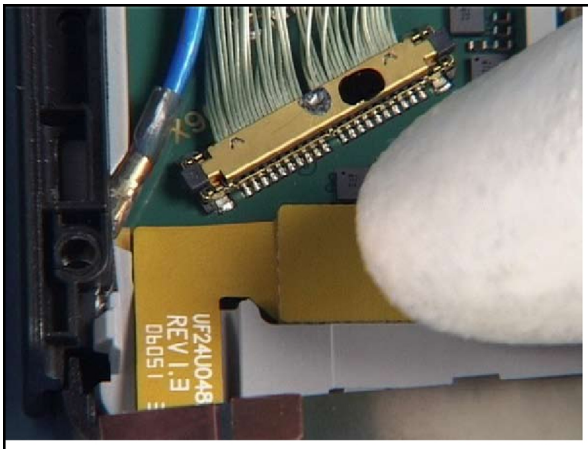
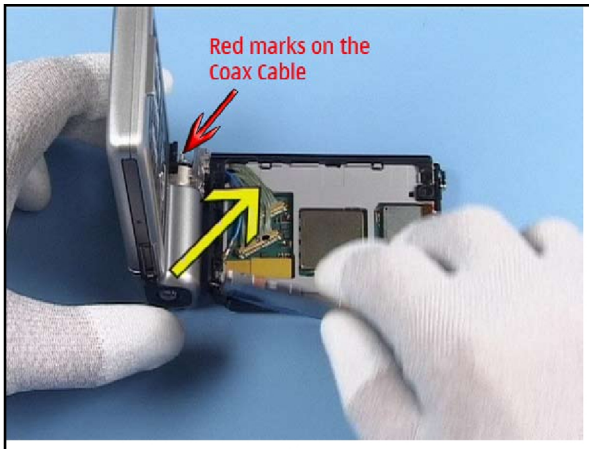
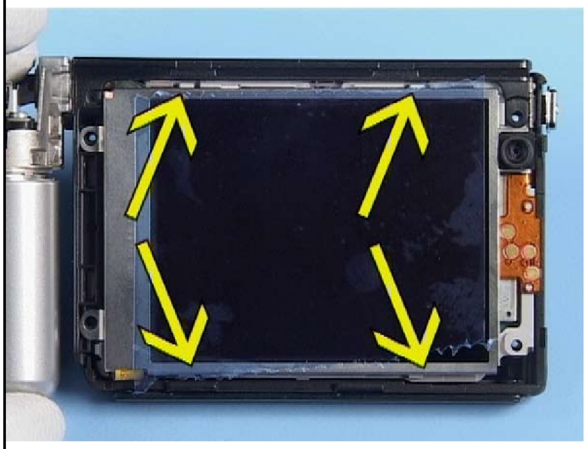



19. Close the display connector.



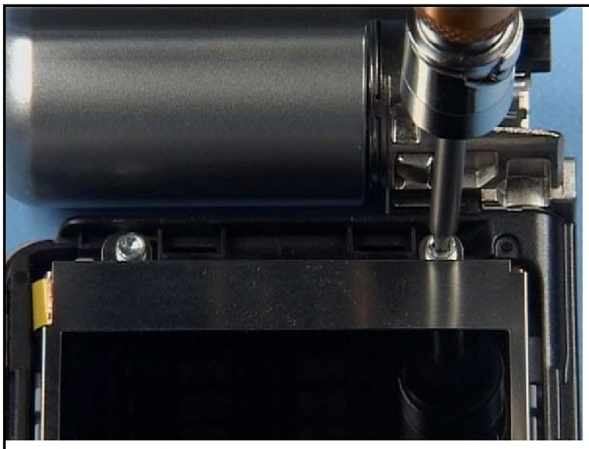

20. Check the positioning of the cables again before going on. The “red marks” on the **Coax Cable** must be visible.



21. Click the four snaps of the display into their places.

22. Insert new screws.

23. Set the correct torque.



24. Tighten both screws.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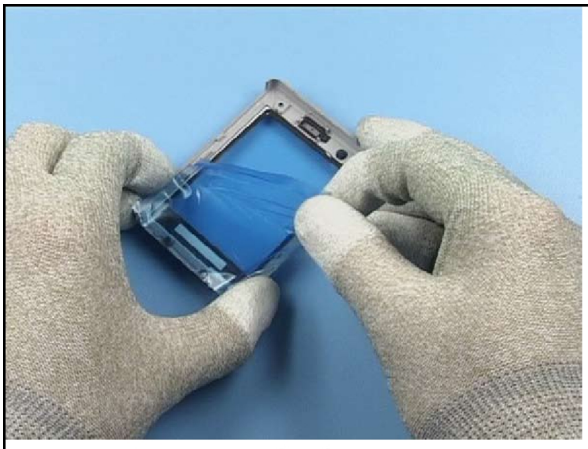
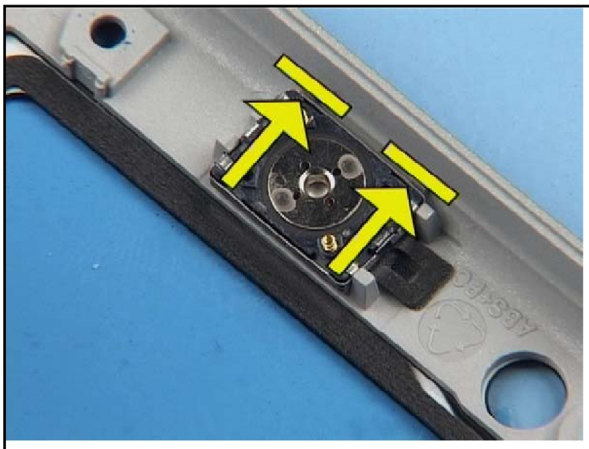


25. Peel up the protective film first.

26. Insert the **Earpiece**. Always use a new Gasket.



27. Push it down evenly, position it as shown.

28. Remove the protective film, if not already done.

29. Place the **B-Cover**, beginning from the hinge side. Push it down evenly at the corners.

30. Now smooth it down evenly to click the side clips into their places.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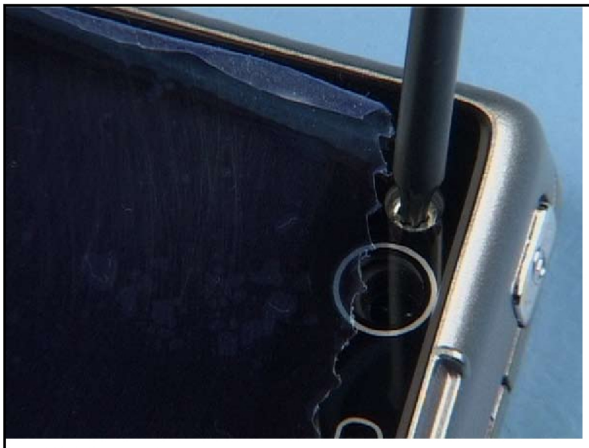
31. Insert new screws.

32. Set the correct torque.



33. Tighten both screws.

34. Place the **Bumper Plug**. Do not scratch the window.

35. Close the assembly.

36. Remove the protective film from the display.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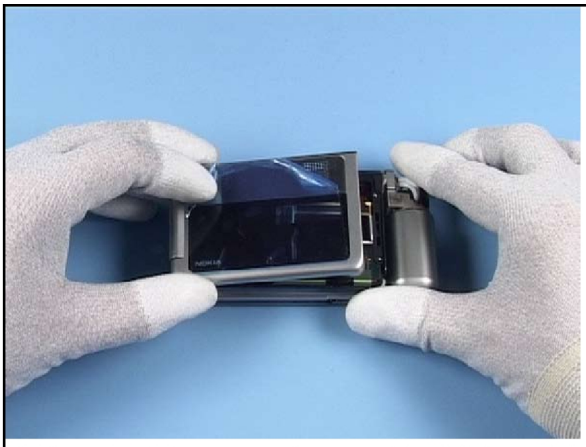
37. Assemble the **Memory Card Door** not already done before going on.

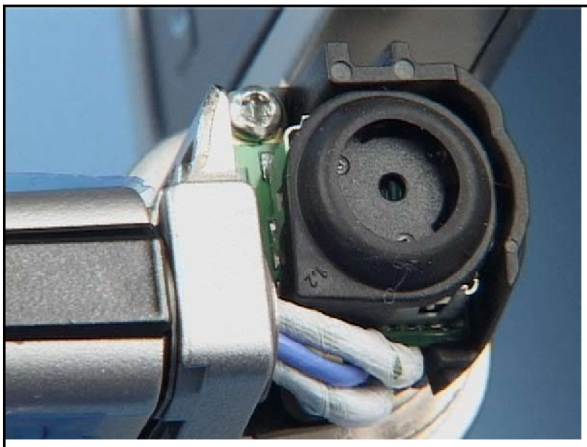


38. Place the **A-Cover** over the assembly, shift it carefully into hinge direction.

39. Push down at the hinge side to click the clips into their places.

40. Use the SS-45 camera removal tool to assemble the **Camera Module 2Mpix** as shown.

41. Note the correct positioning of the camera.



42. Place the **Camera Elastomer**.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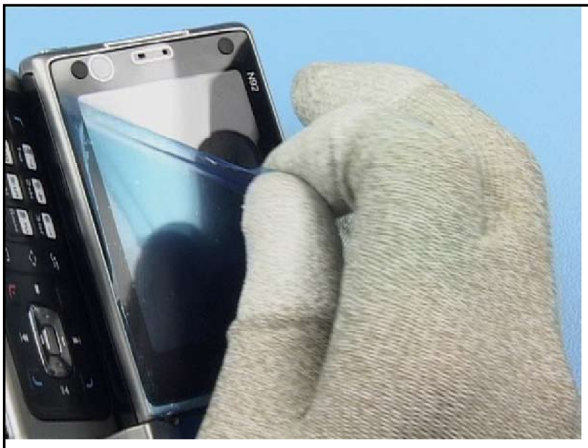
43. Turn the assembly into position shown and place the **Hinge Cover B** first.

44. Click it into its place.

45. Now place the **Hinge Cover A**, push it down evenly.



46. Check the windows for cleanness.

47. Complete the Unit with the **Battery Cover**.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## LOWER BLOCK DISASSEMBLY

1. Needed tools: The SRT-6, the SS-93, metal tweezers, a dental pick, a torque driver with Torx plus size 6 bit, a Torx plus size 6 driver, and a DC plug.

2. Cover all windows with a protective film and remove the battery if it is inserted.

3. Carefully unlock the latches of the **D-Cover** on both sides with the SS-93.

4. Now, the **D-Cover** can be removed easily.

5. Unlock the snaps of the **C-Cover** on the top.

6. Carefully release all the other snaps of the **C-Cover**.


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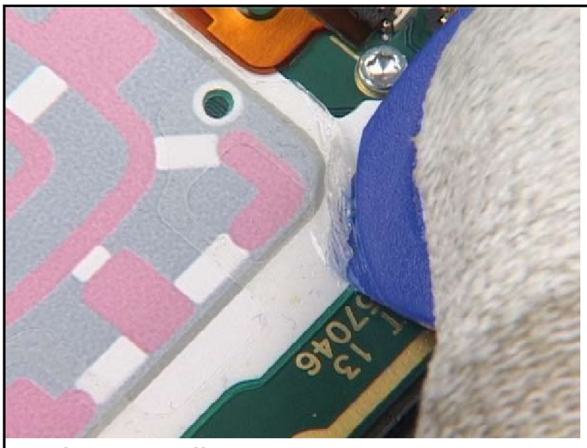
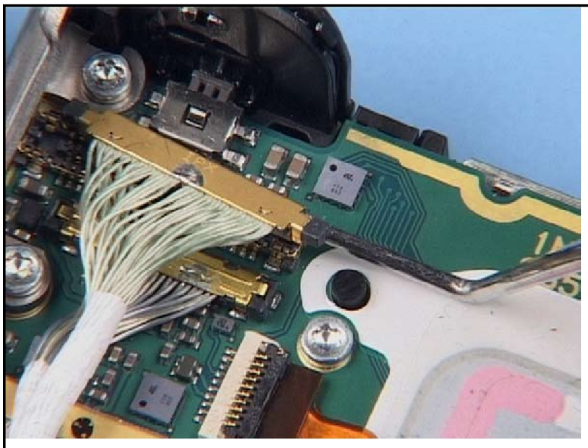
7. Remove the **C-Cover** now.

8. Release the glued **Keymat**, beginning at the edge with the SRT-6, mind the dome sheet.

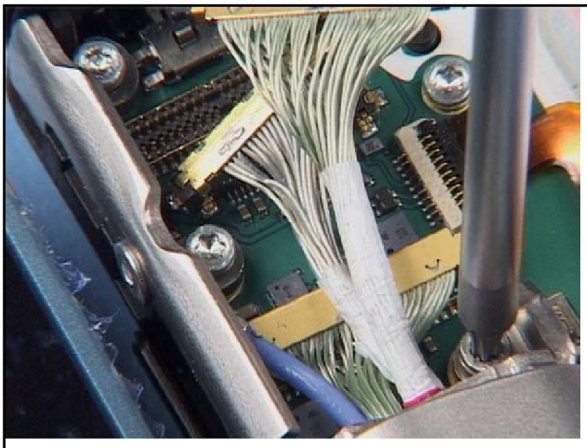
9. Carefully peel off the **Keymat**.



10. Lift and peel off the adhesive tape. Remove all adhesive residues.



11. Carefully open the three coax connectors with the dental pick as shown, note that there are 2 different kind of opening methods required.



12. Unscrew the three Torx size 6 screws and discard them.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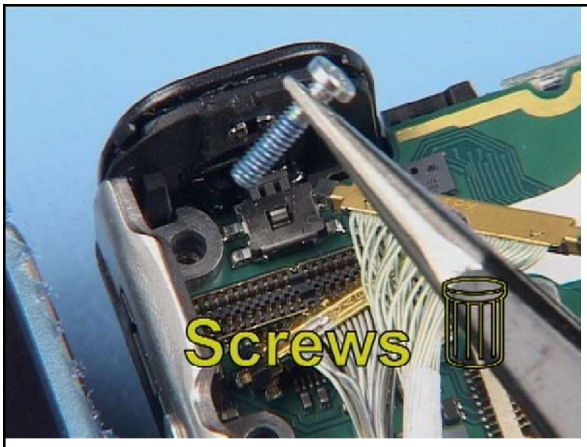
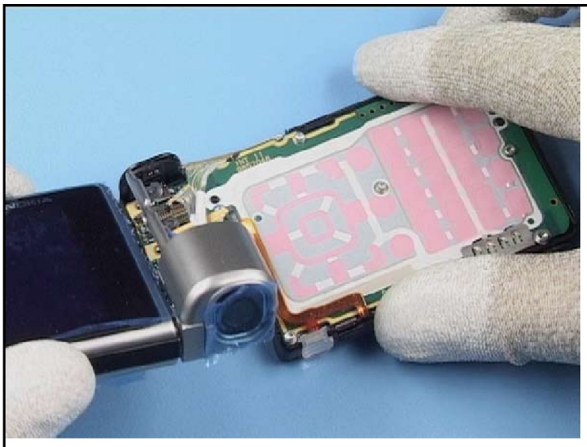
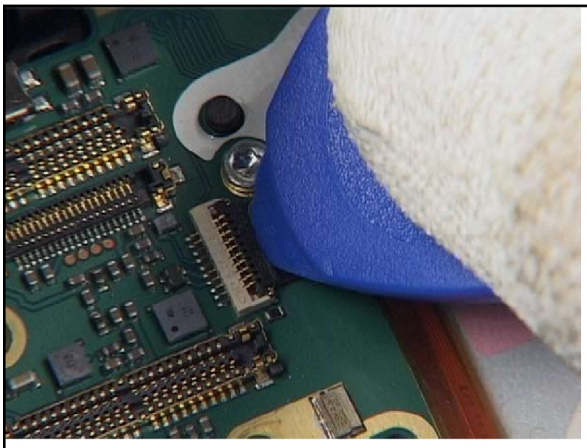


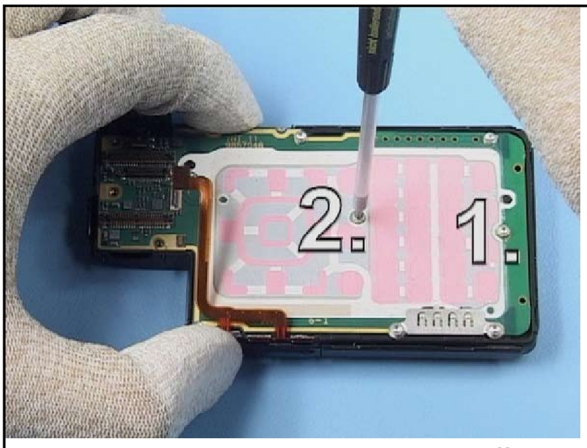

13. Do not use them again.



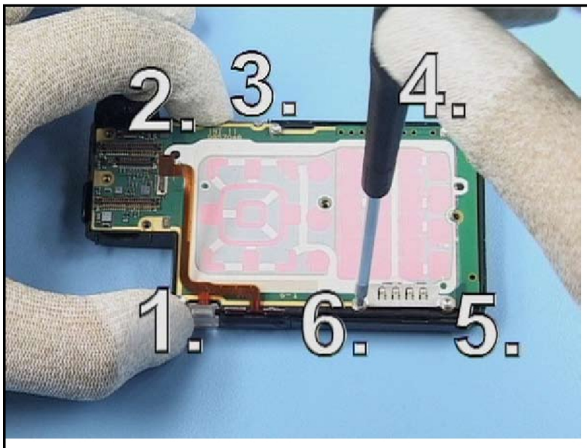
14. Now the parts can be separated.



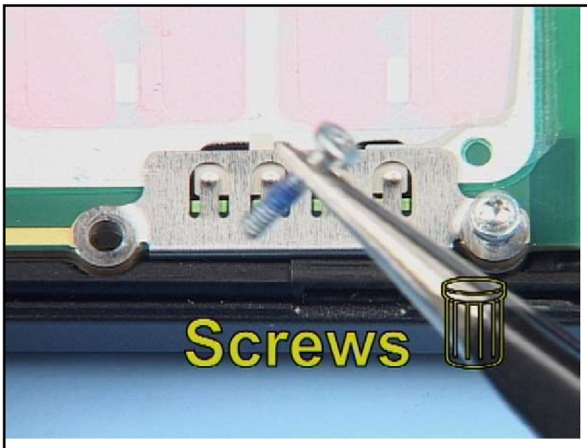
15. Open the Flex foil connector with the SRT-6.




16. Undo the 2 Torx screws. These screws are different to the others, do not mix them.




17. Now unscrew the other screws in the shown order and discard them.




18. Do not use them again.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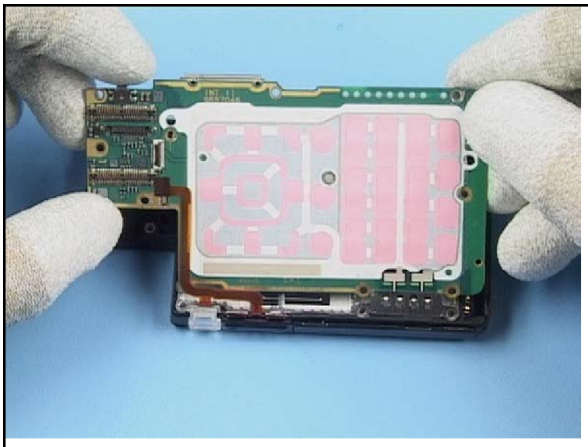
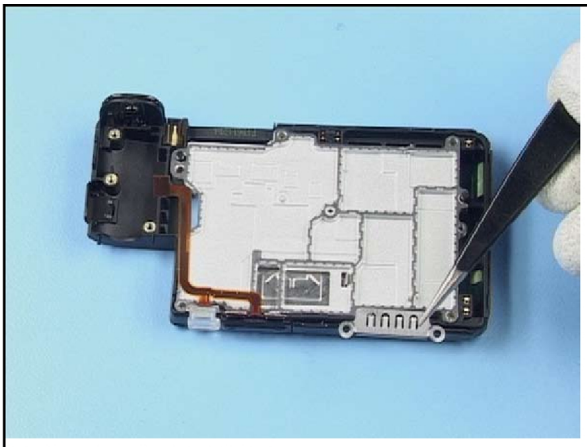
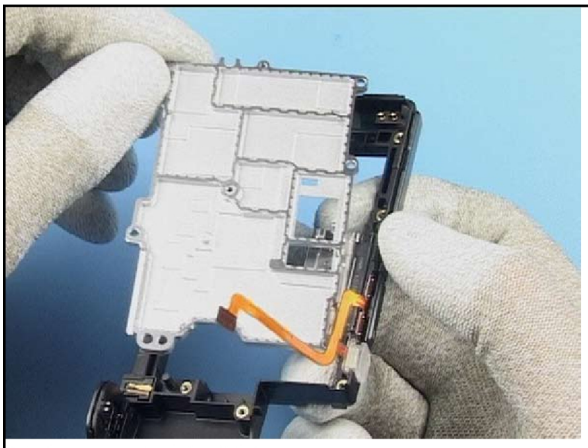


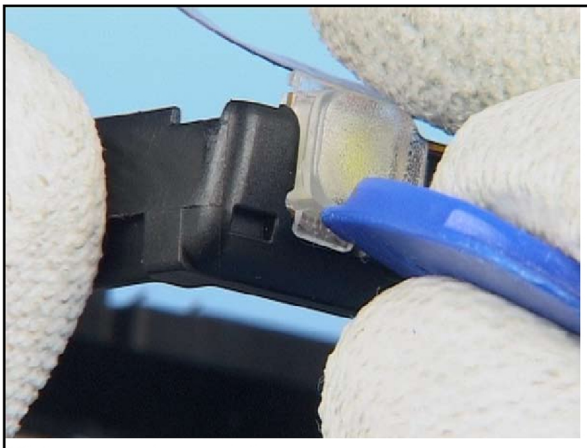
19. Remove the **Engine Module**.



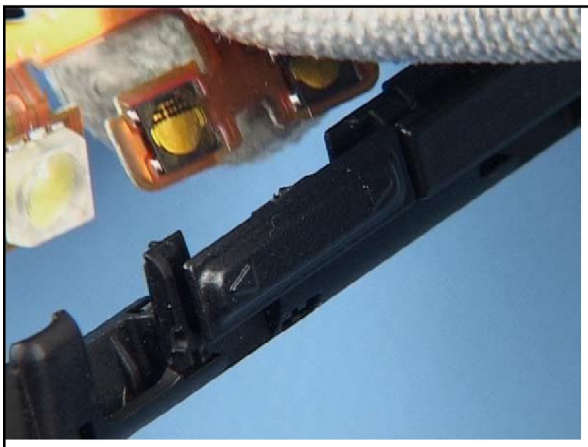
20. And the **EL Shield Plate**.



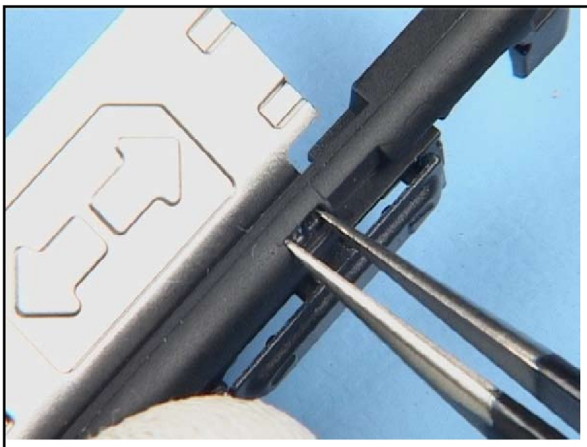
21. Remove the **Shield Assy**.



22. Lever out the **Flash Lens**.



23. Carefully pull out the **Bottom Frame Flex Assy**.



24. Unlock the snaps of the **Volume Bottom** first, then push it out.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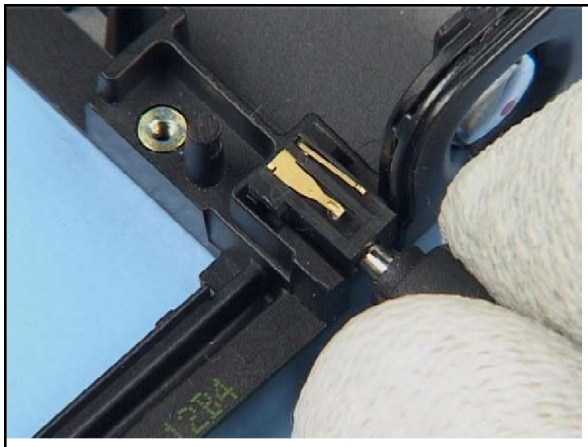
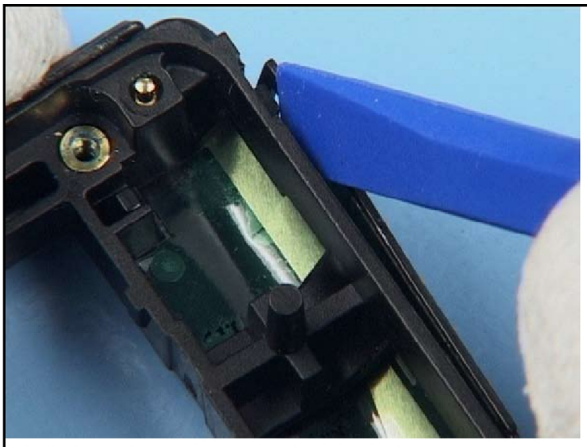
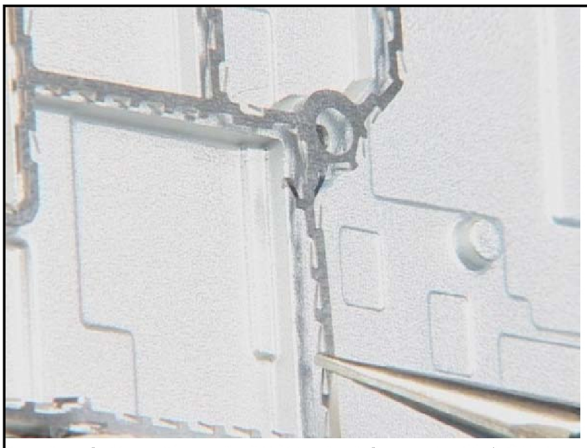


25. Release the **DC Jack** with a DC Plug.



26. Unlock the snaps of the **Antenna Assy**.

27. Pull out the **Microphone**.



28. Carefully pull up the **RF Gasket** from the **Shield Assy**.

29. The disassembly procedure is now completed.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## LOWER BLOCK ASSEMBLY

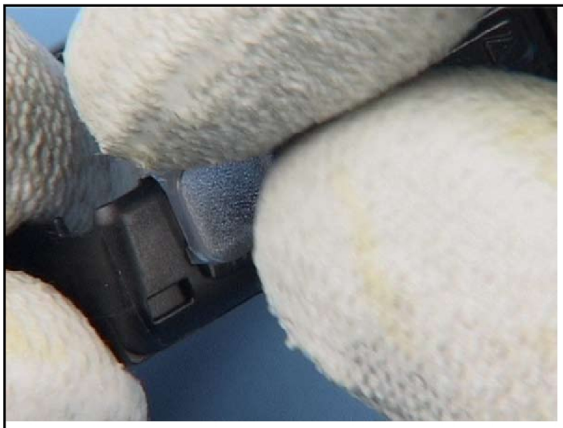
1. Assembly.

2. Insert the **Microphone** into its recess.

3. Place the **Antenna Assembly**. Check that all 5 snaps are locked properly.

4. Insert the **DC Jack** into its compartment.

5. Place the **Volume Button** into the **Bottom Frame Assy**.



6. Insert the **Flash Lens**.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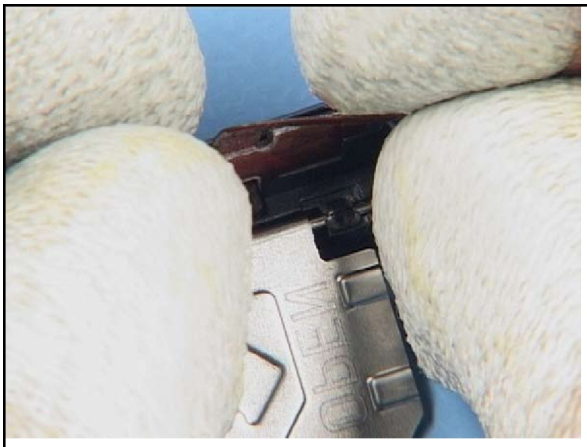
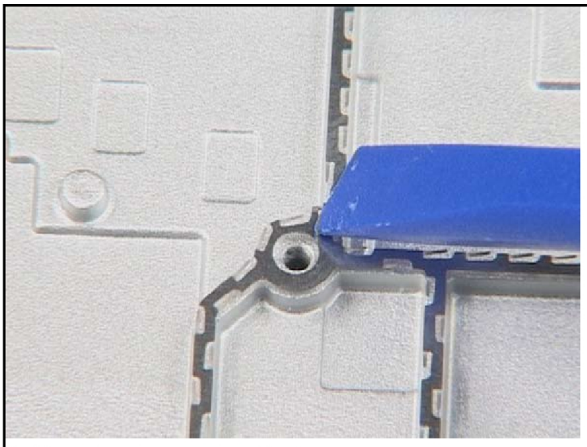
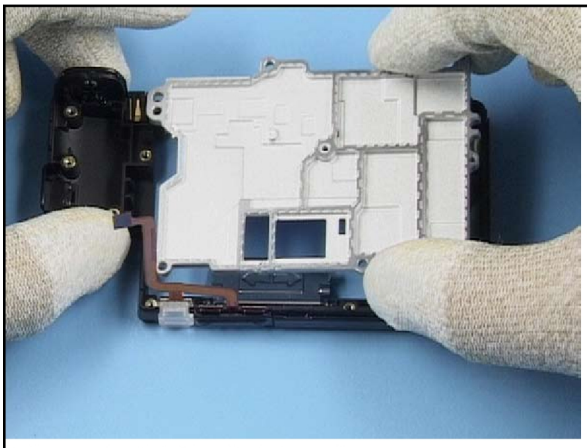


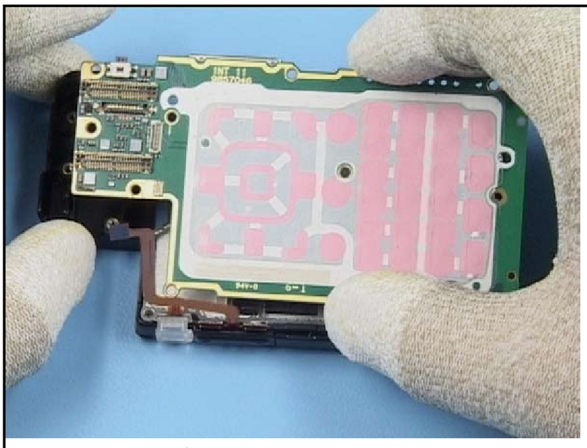
7. Now insert the **Bottom Frame Flex Assy**.



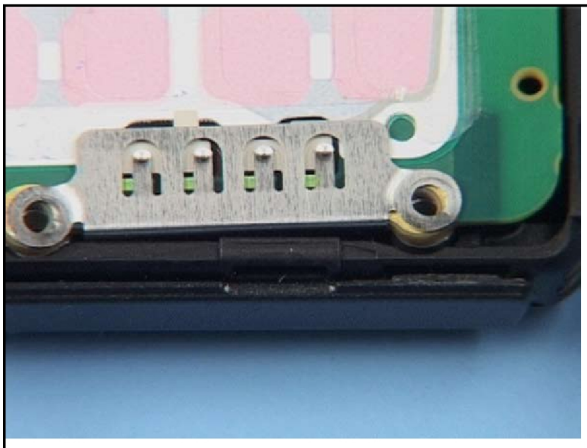
8. Place the **Grounding Gasket**.



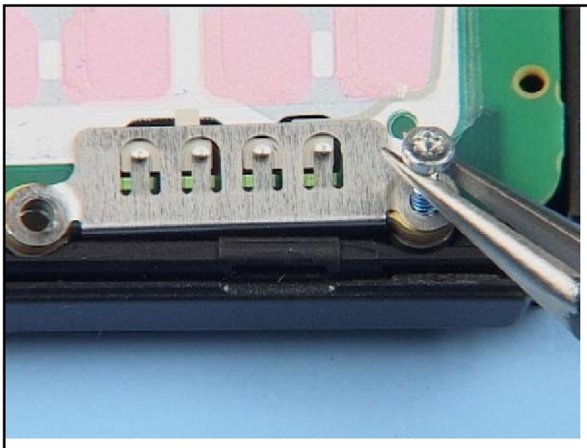
9. Insert the Shield, mind the guides.



10. Place the **Engine Module**.



11. Place the **EL Shield Plate**.



12. Insert 6 new screws and tighten them slightly.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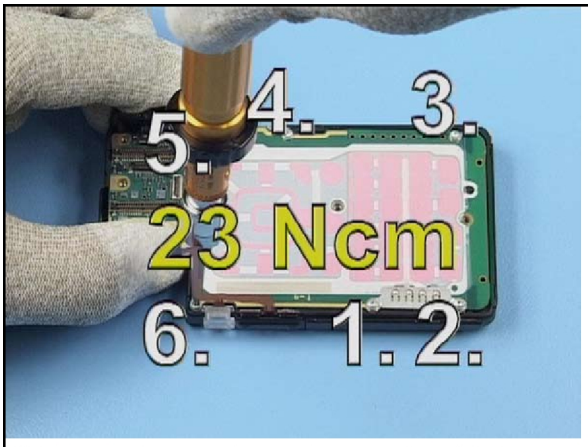
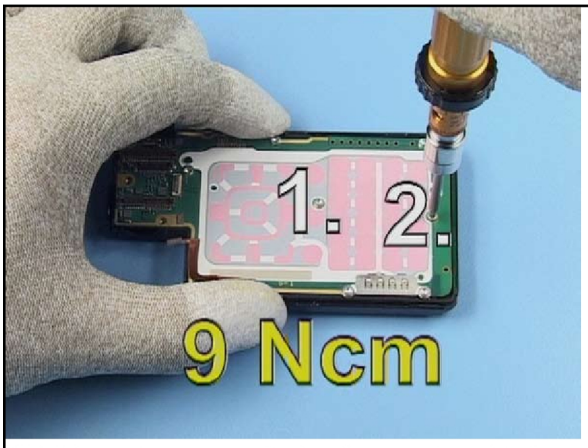


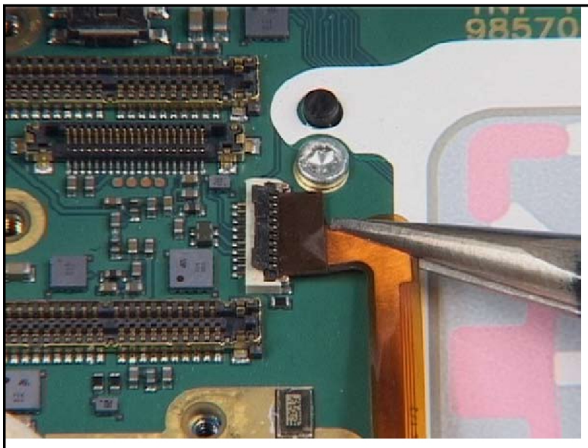

13. Tighten all screws in the shown order with the correct torque.

14. Insert the two short screws.

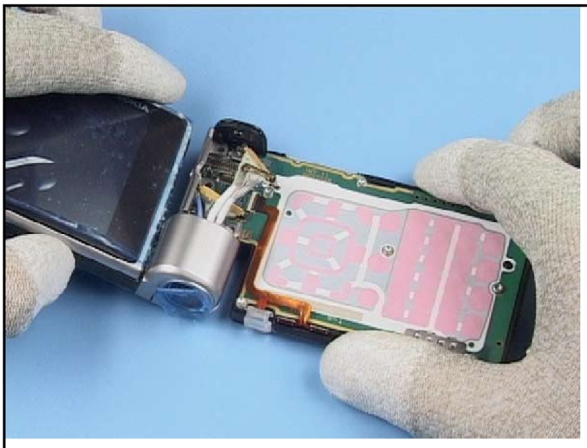



15. Tighten these screws in the shown order with the correct torque, too.

16. The Shield can be reused 4 times only. If it is not possible to tighten these 2 screws correctly, the Shield and **Type Label** must be replaced.



17. Insert the flex foil and close the connector.



18. Couple the parts as shown.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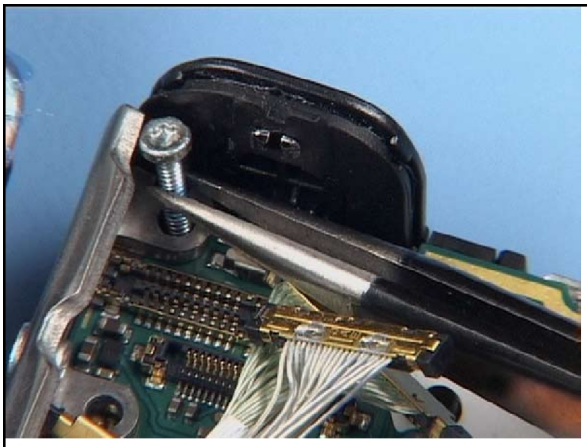
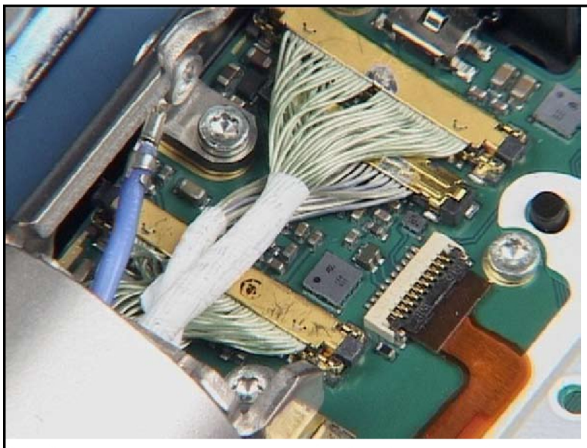


19. Insert three new screws.

20. Tighten these screws with the correct torque.



21. Close the coax connectors in the shown order.

22. Place the **C-Cover** and click all snaps into their places.

23. Insert the **Keymat**. Do not touch the adhesive surface.

24. Turn the unit and join the parts, beginning from the bottom. Click all snaps into their places.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25. Complete the unit with the **Battery Cover**.


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# 6 — BB Troubleshooting and Manual Tuning Guide


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## Baseband troubleshooting

### Context

This section is intended to be a guide for localising and repairing electrical faults. The fault repairing is divided into troubleshooting paths. The following main troubleshooting tree describes the different baseband troubleshooting paths to be followed in fault situations.


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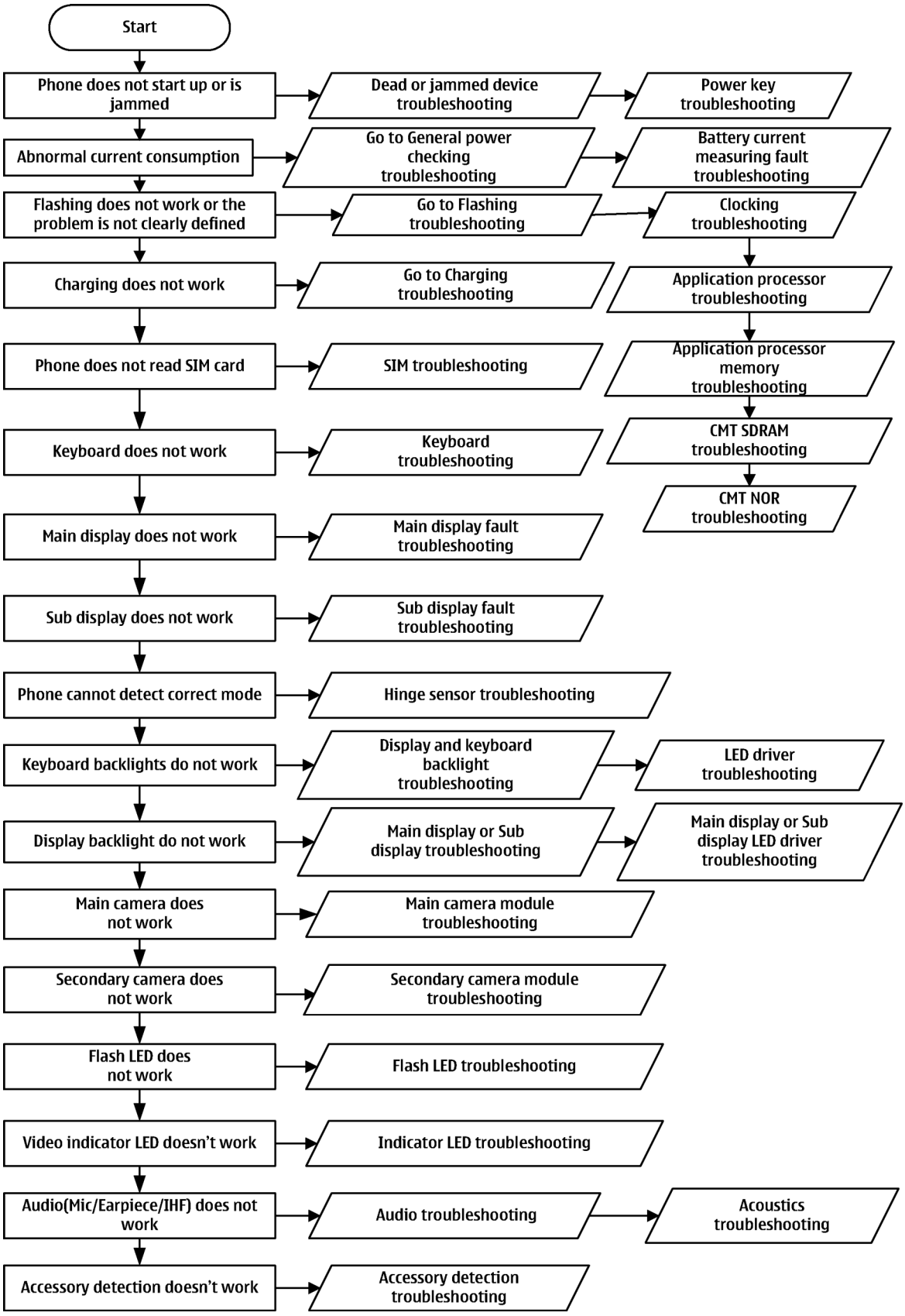
## Troubleshooting flow





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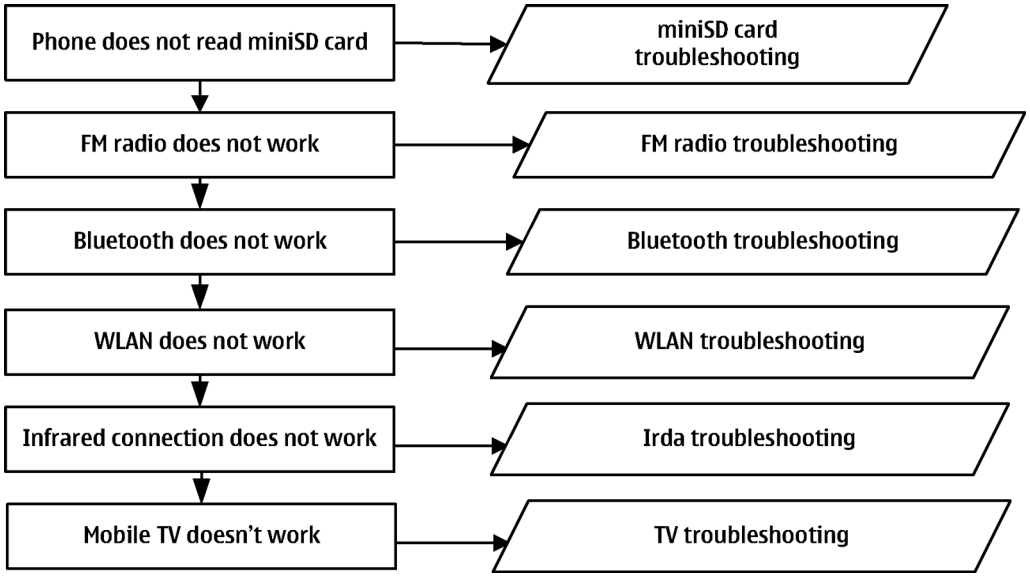



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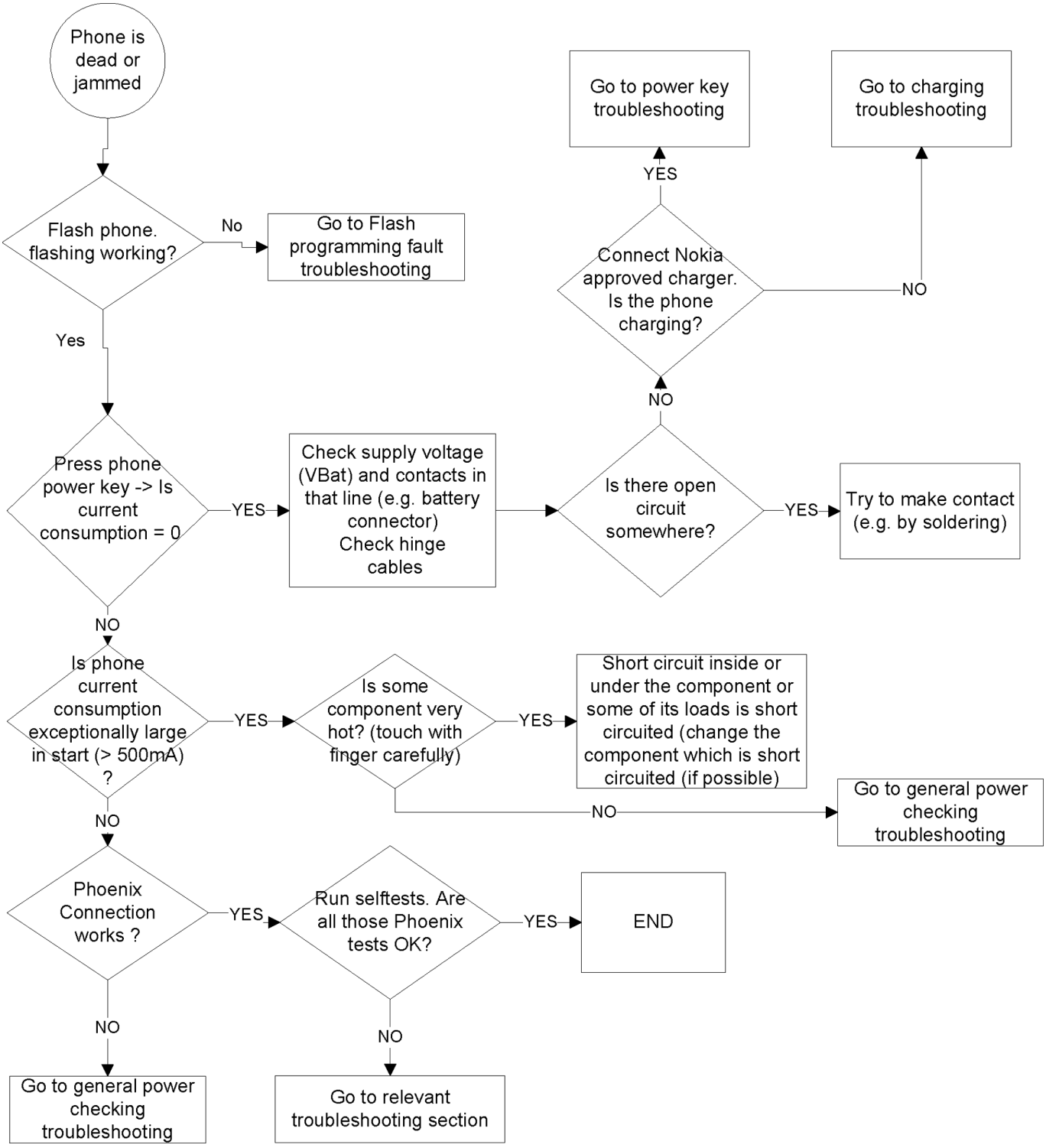
## Dead or jammed device troubleshooting

### Troubleshooting flow





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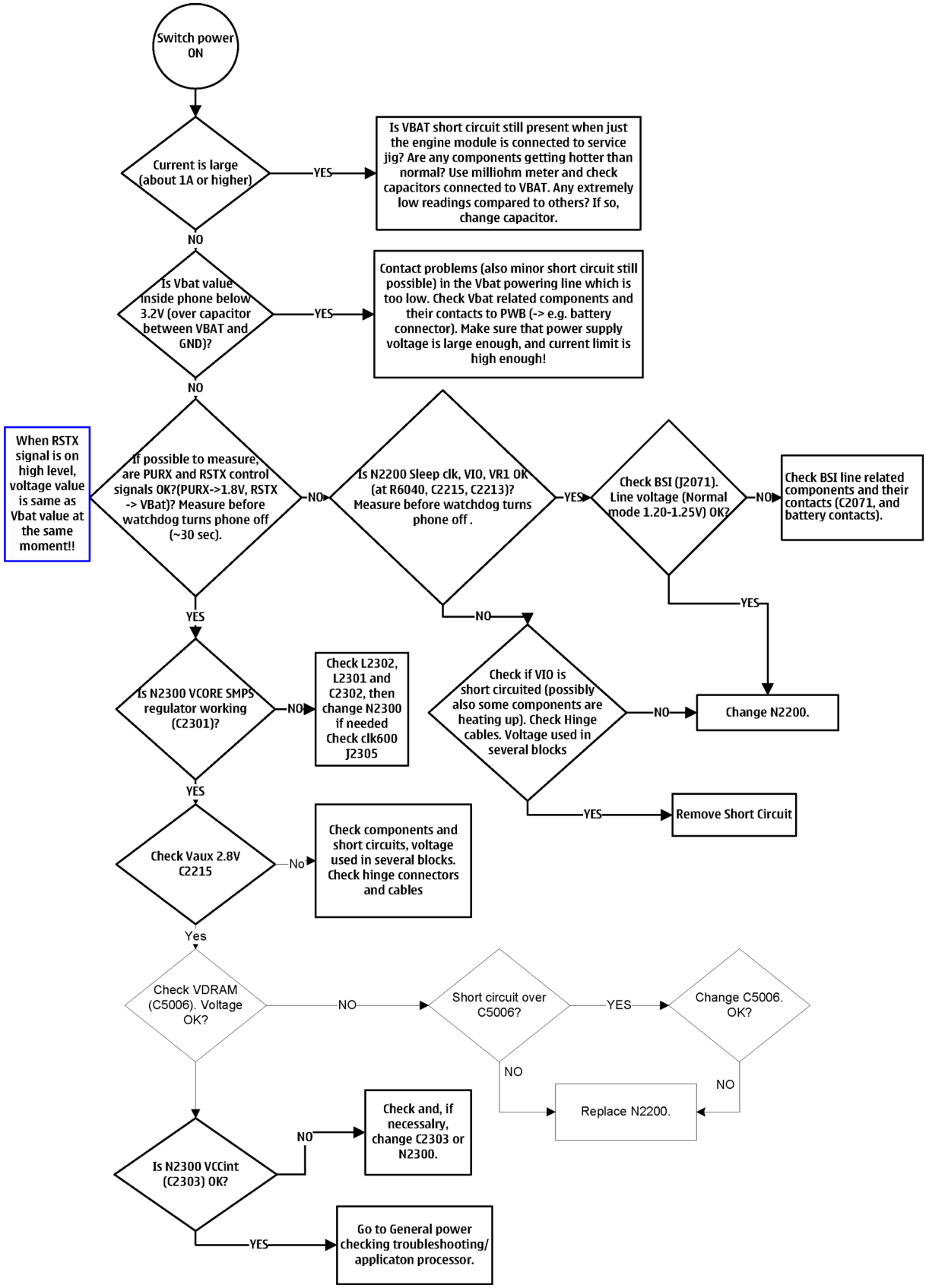
## General power checking troubleshooting - CMT

### Troubleshooting flow





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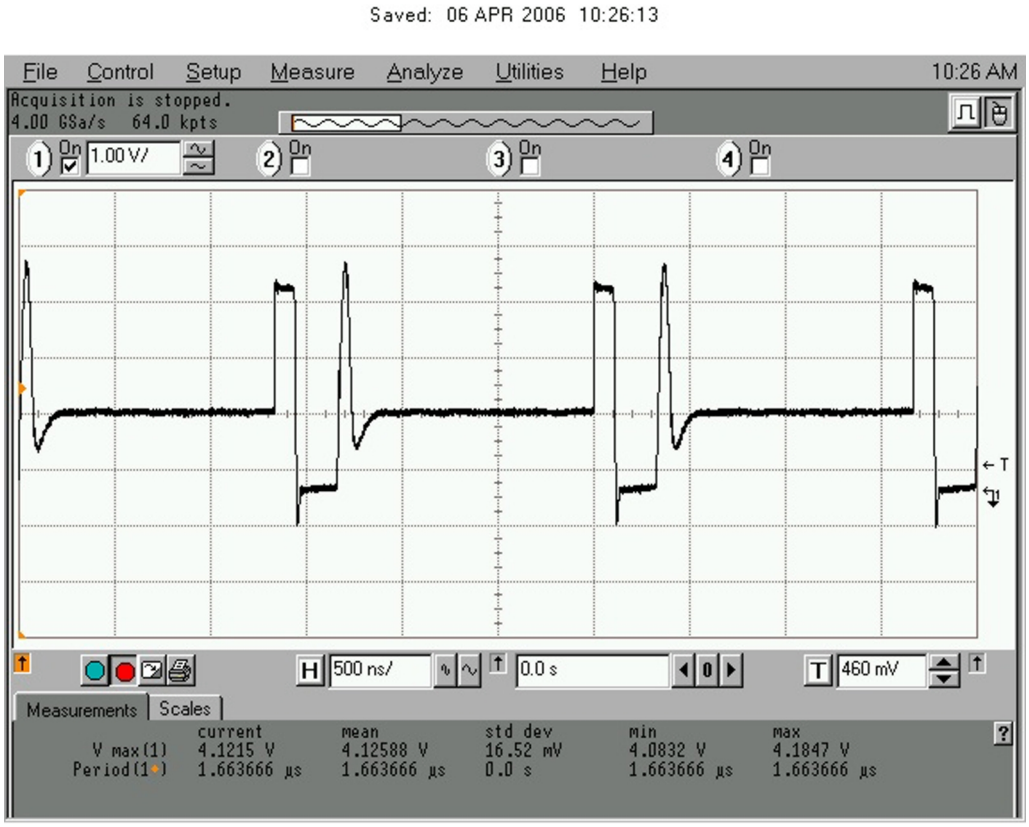


**Figure 35 L2302 Vcore SMPS coil**


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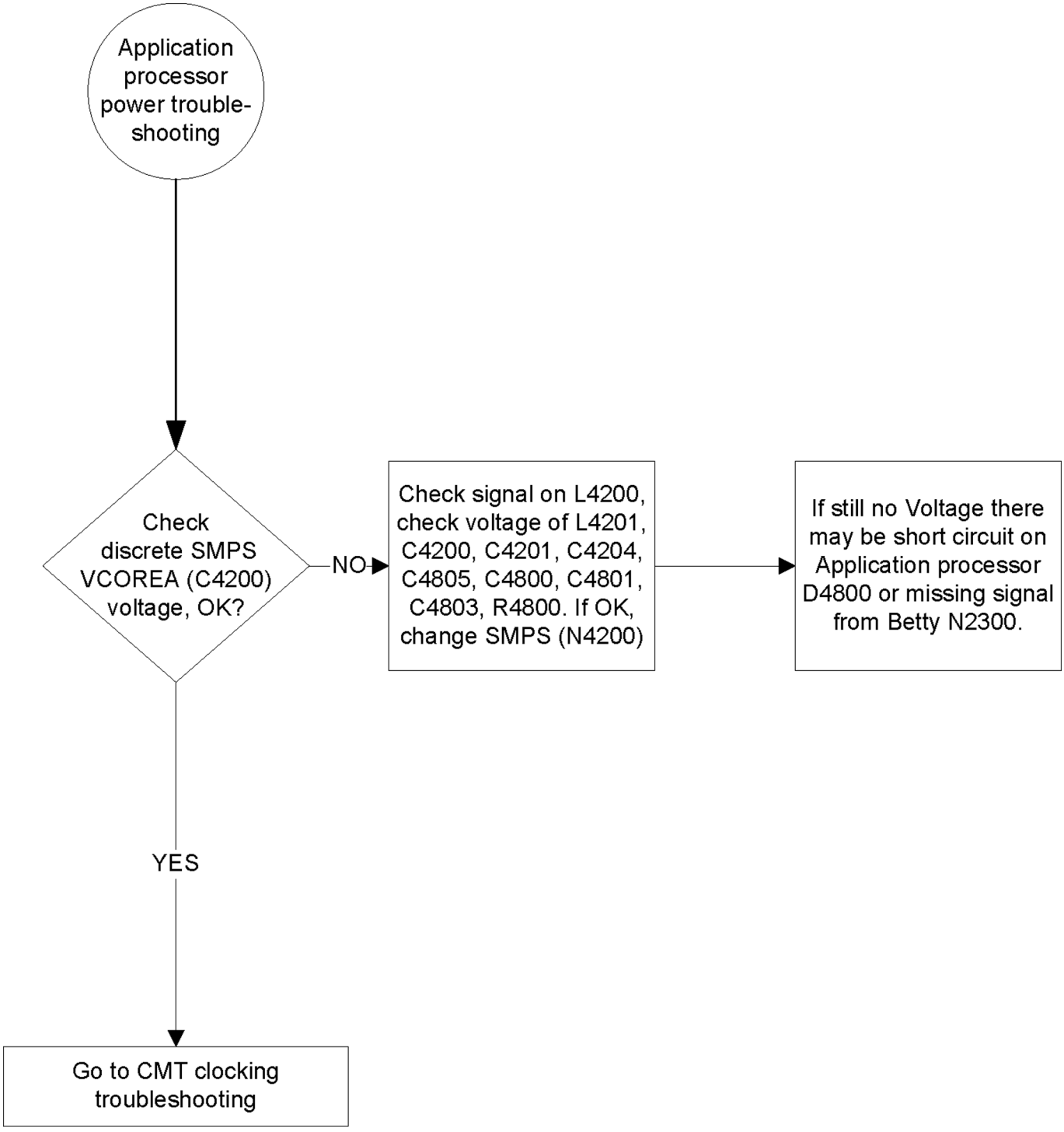
## General power checking troubleshooting - application processor

### Troubleshooting flow





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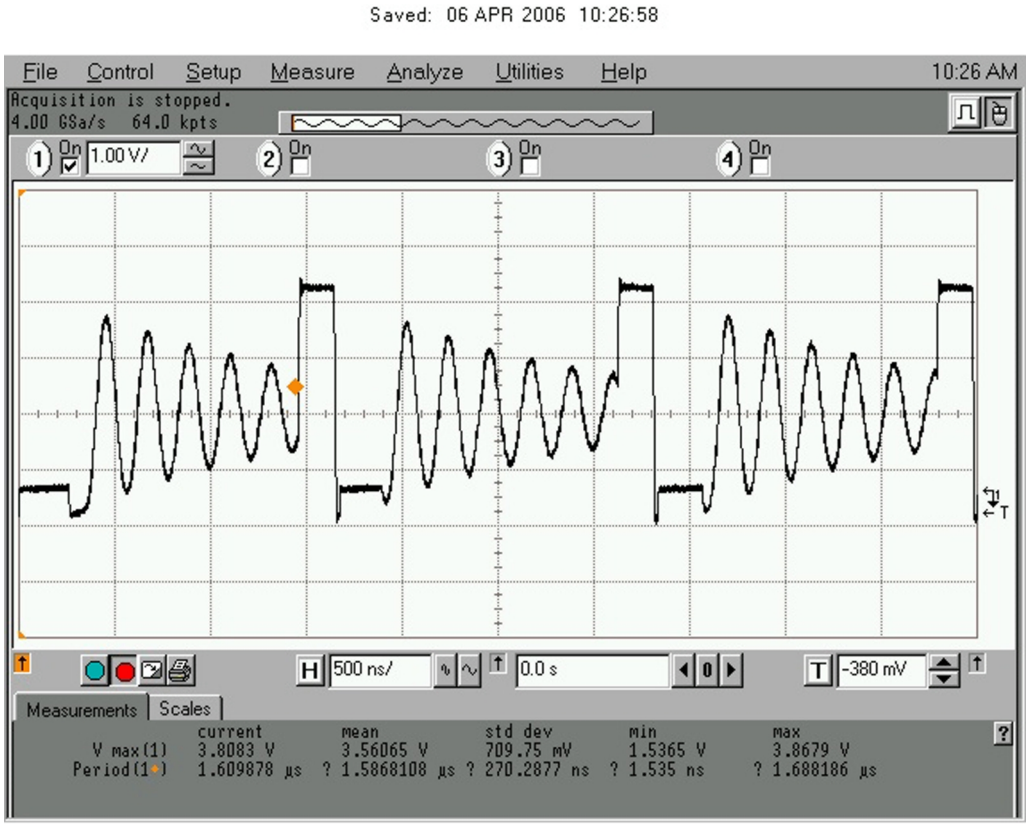


**Figure 36 L4200 VcoreA SMPS coil**


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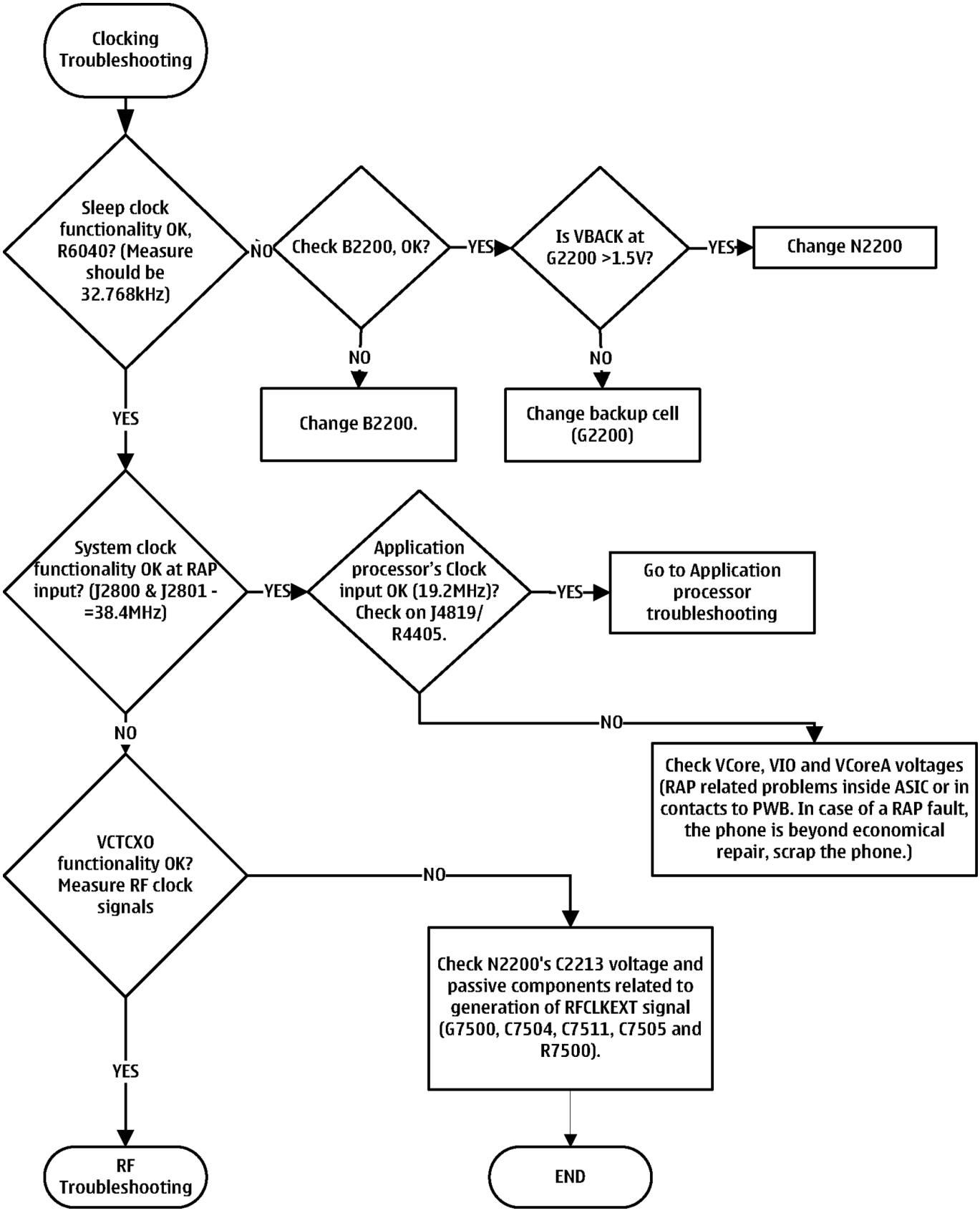
## CMT clocking troubleshooting

### Troubleshooting flow





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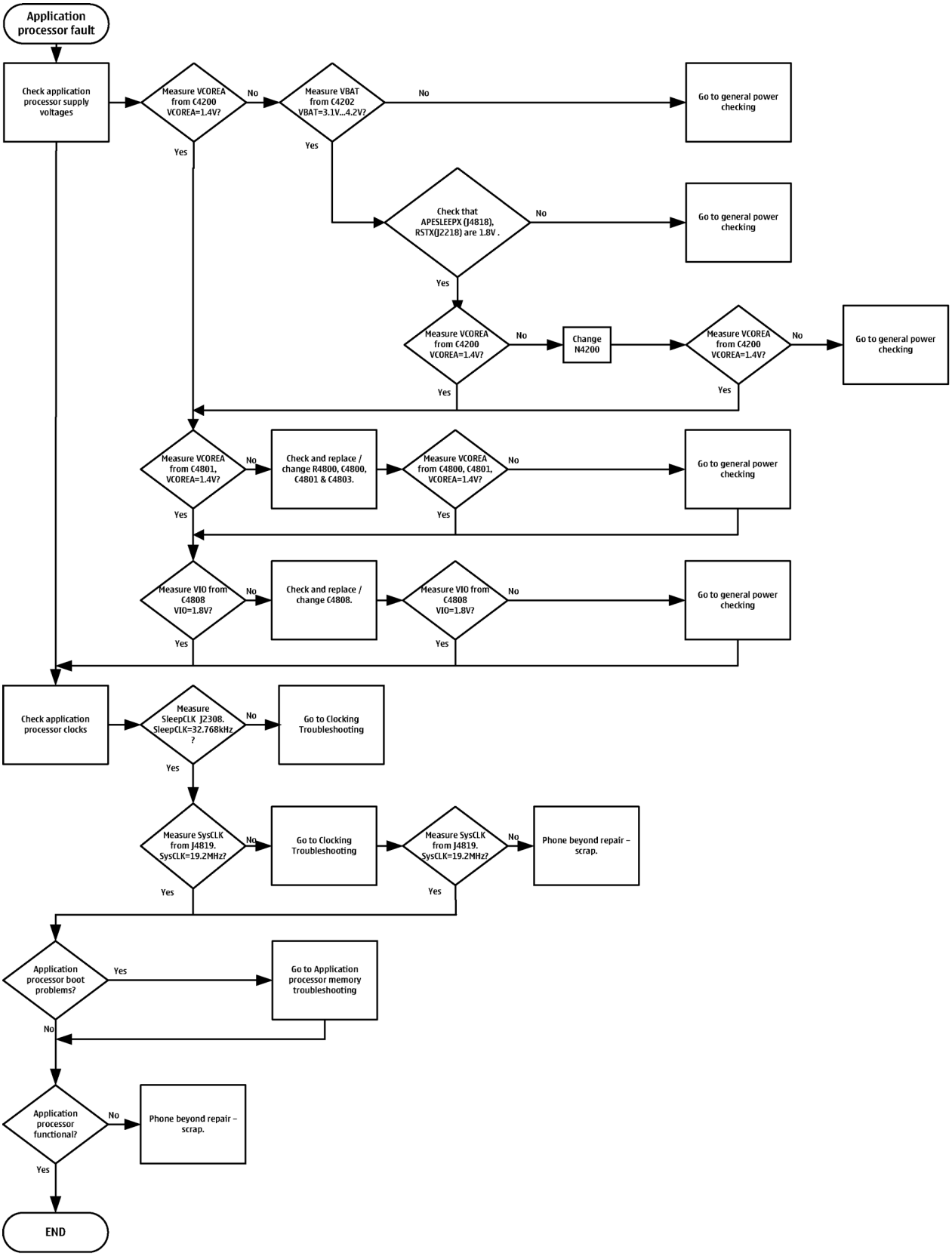
## Application processor troubleshooting

### Troubleshooting flow




Note: It is not possble to change the application processor and combo memory. In this case, the PWB is beyond economical repair.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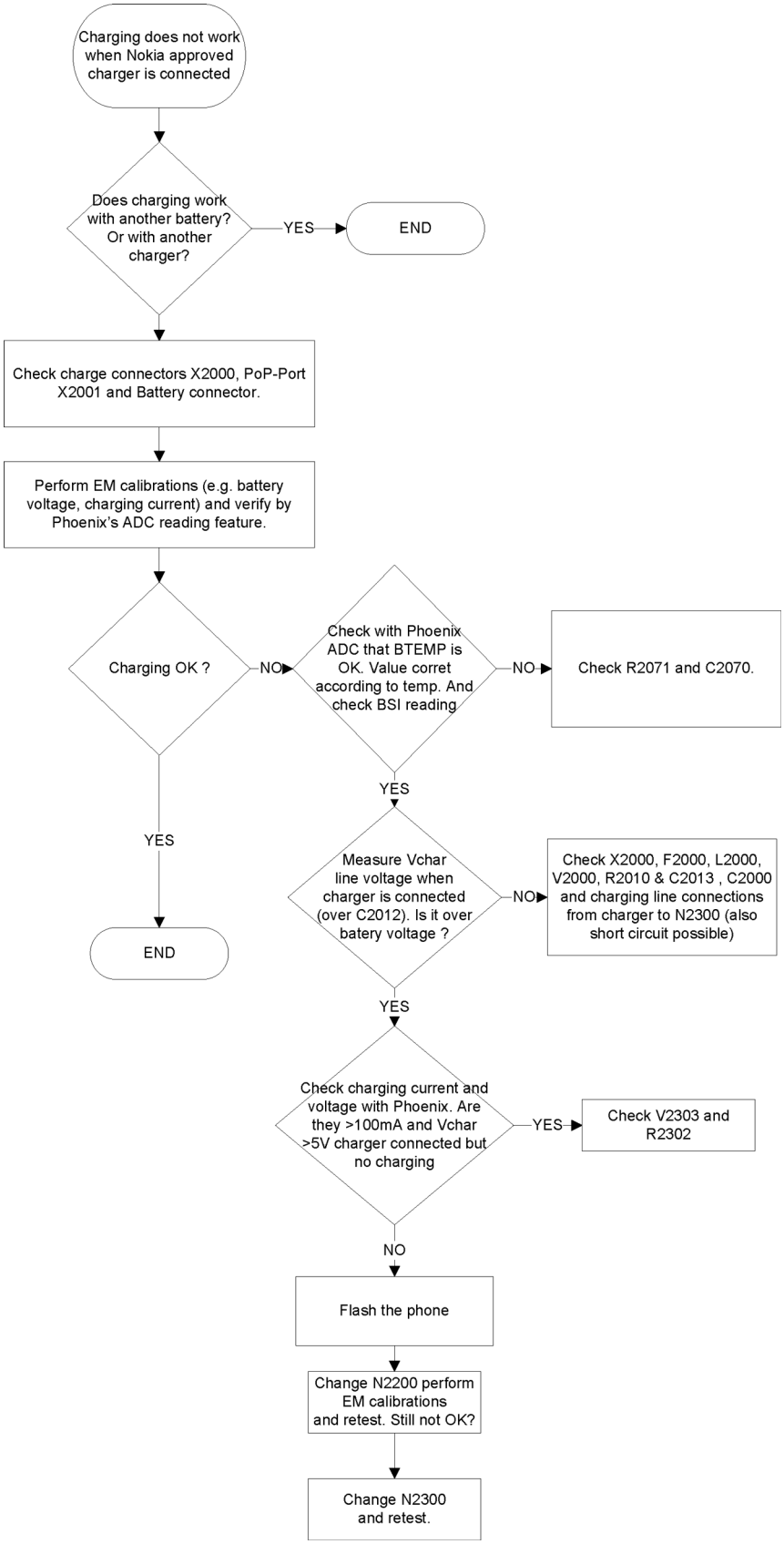
## Charging troubleshooting

### Troubleshooting flow





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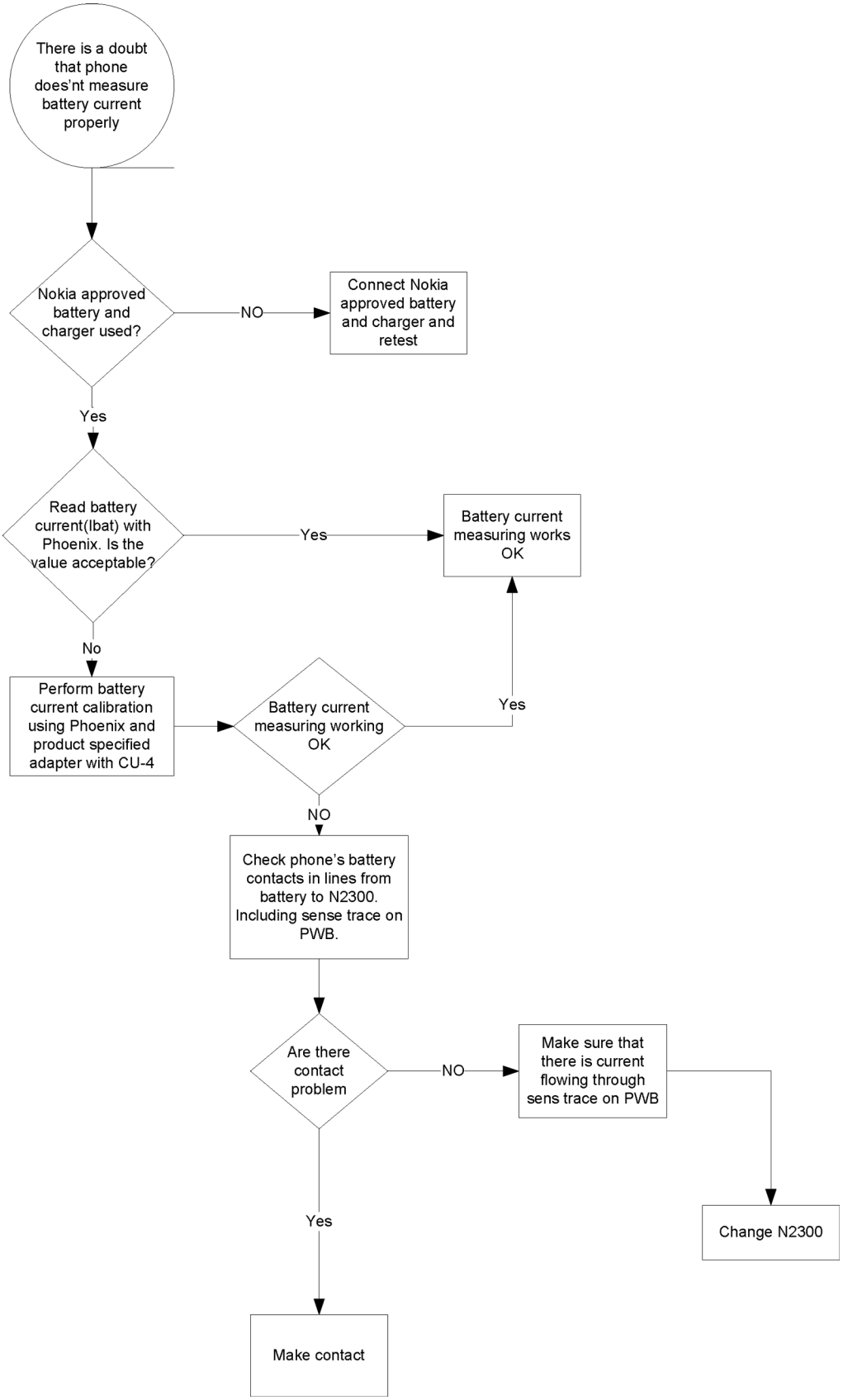
## Battery current measuring fault troubleshooting

### Troubleshooting flow





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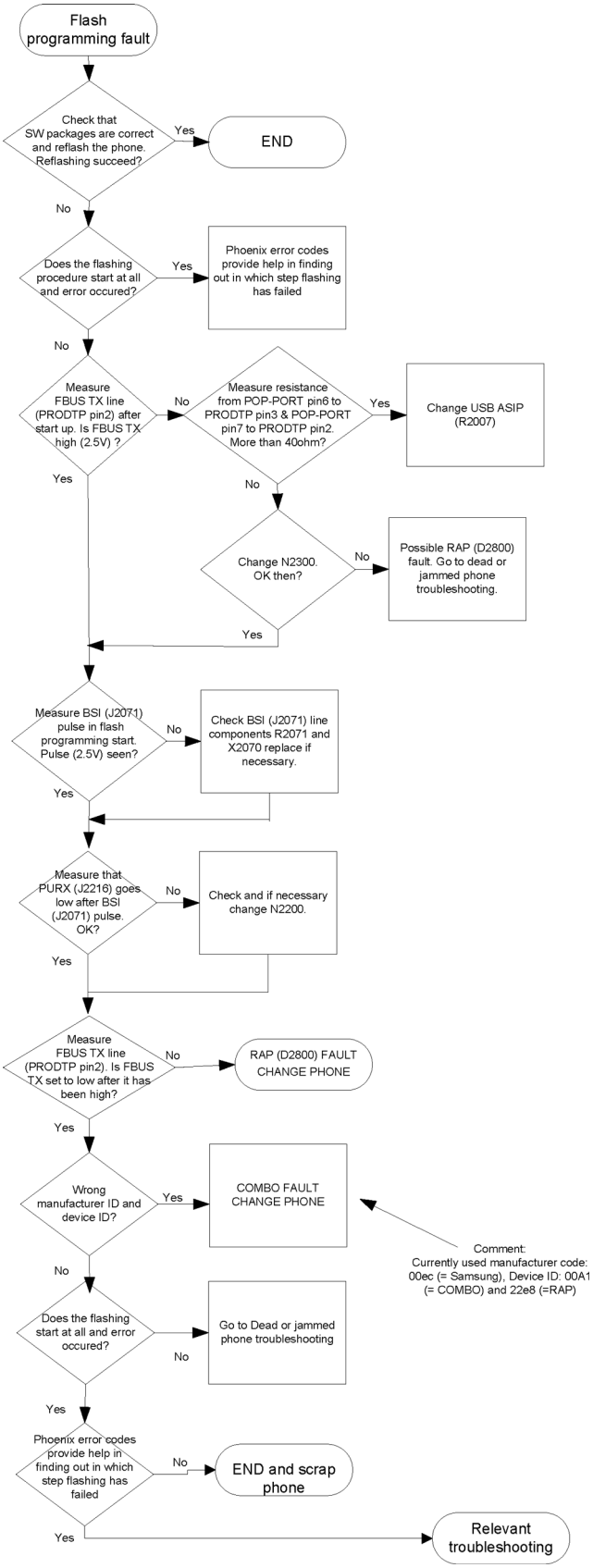
## Flash programming fault troubleshooting

### Troubleshooting flow





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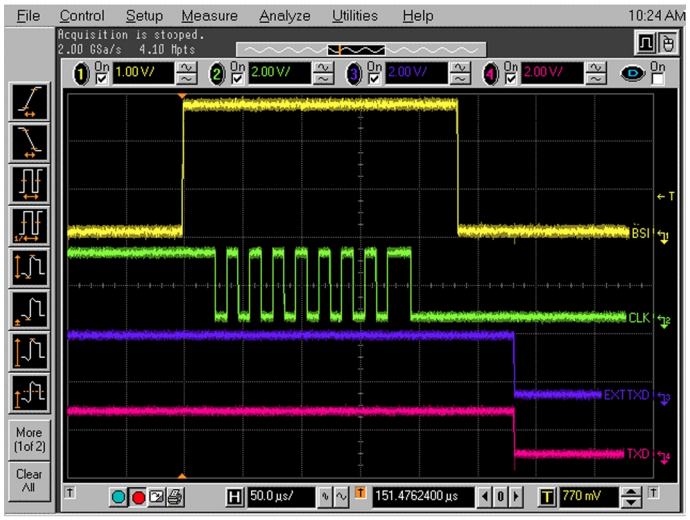


**Figure 37 Flashing pic 1. Take single trig measurement for the rise of the BSI signal.**

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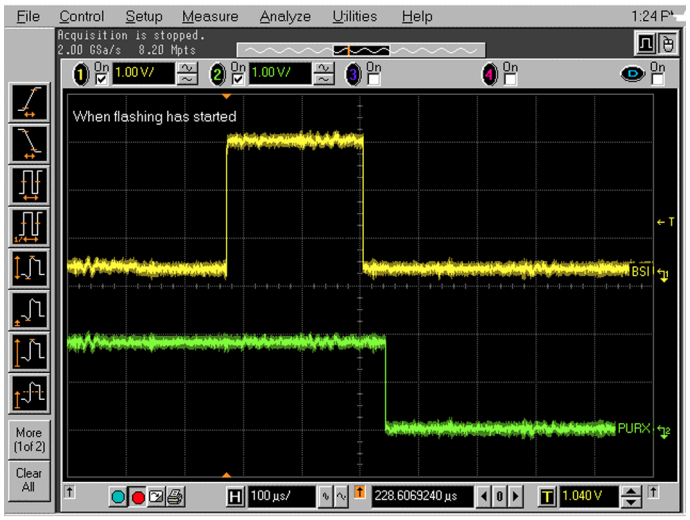


**Figure 38 Flashing pic 2. Take single trig measurement for the rise of the BSI signal.**


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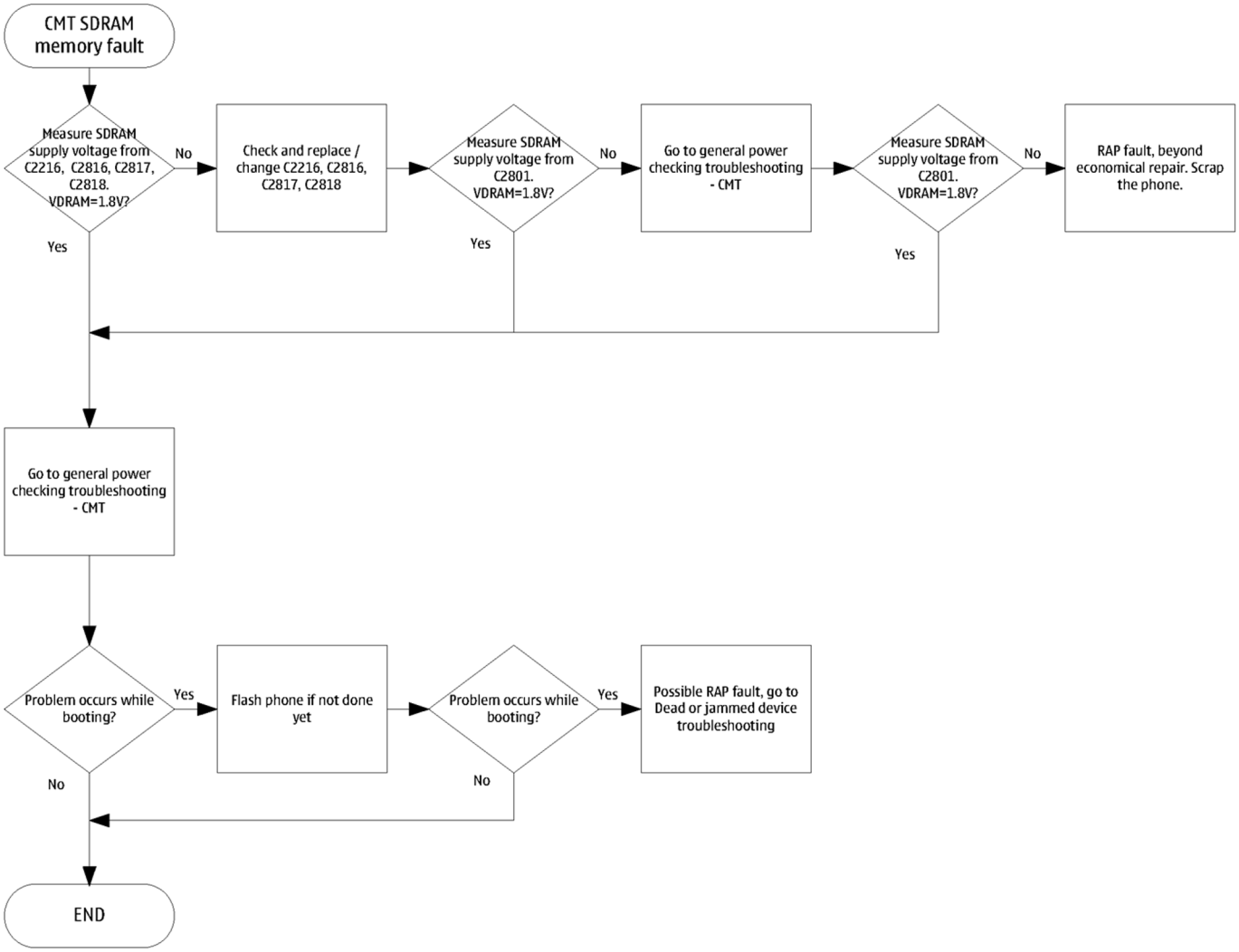
## CMT SDRAM memory troubleshooting

### Troubleshooting flow





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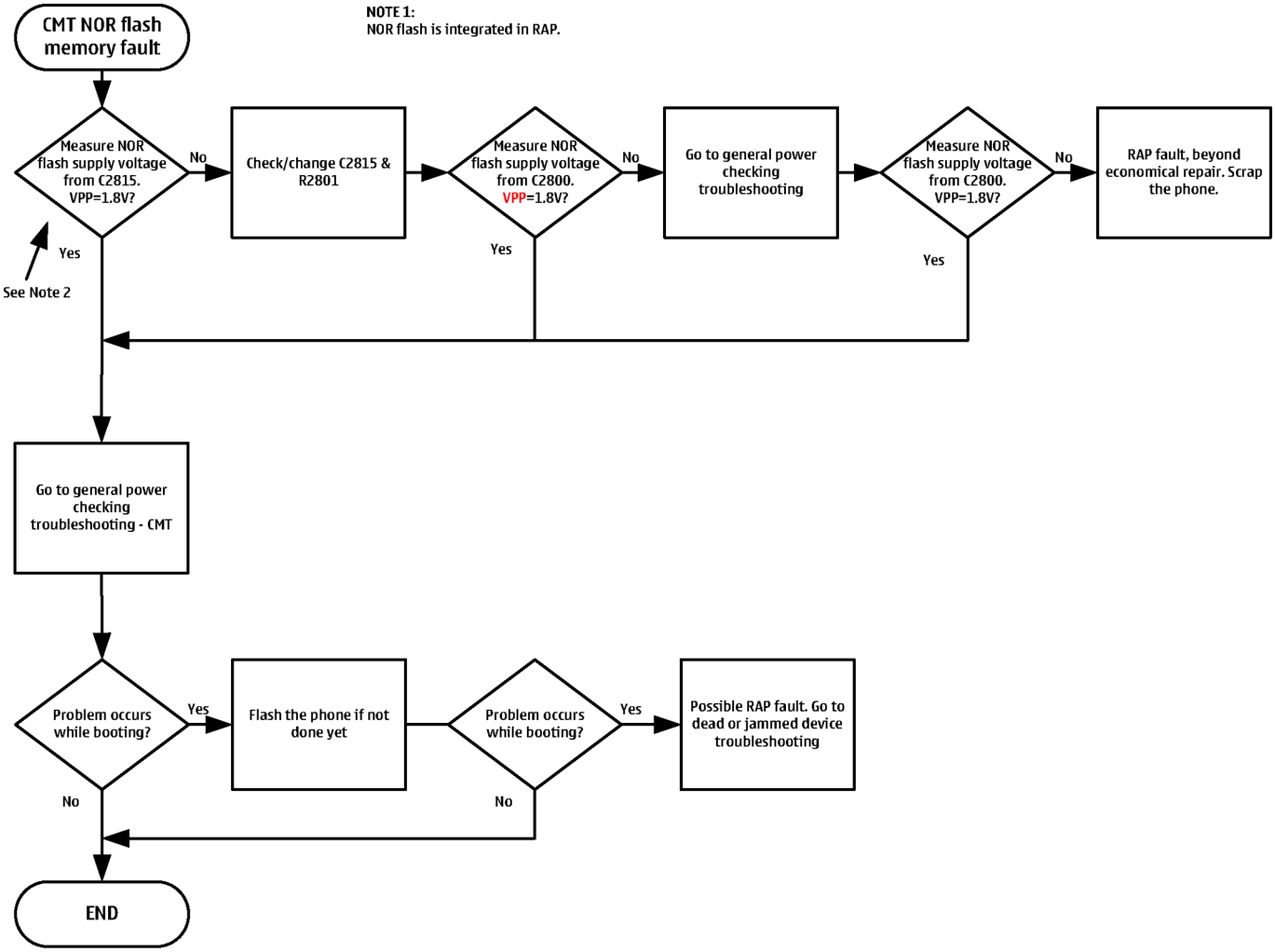
## CMT NOR flash fault troubleshooting

### Troubleshooting flow




NOTE 2: VPP is intitally 1.8V. When Vpp-LED ON FPS-10 goes ON VPP rises to 9V. When USB flashing is used, VPP is always 1.8V.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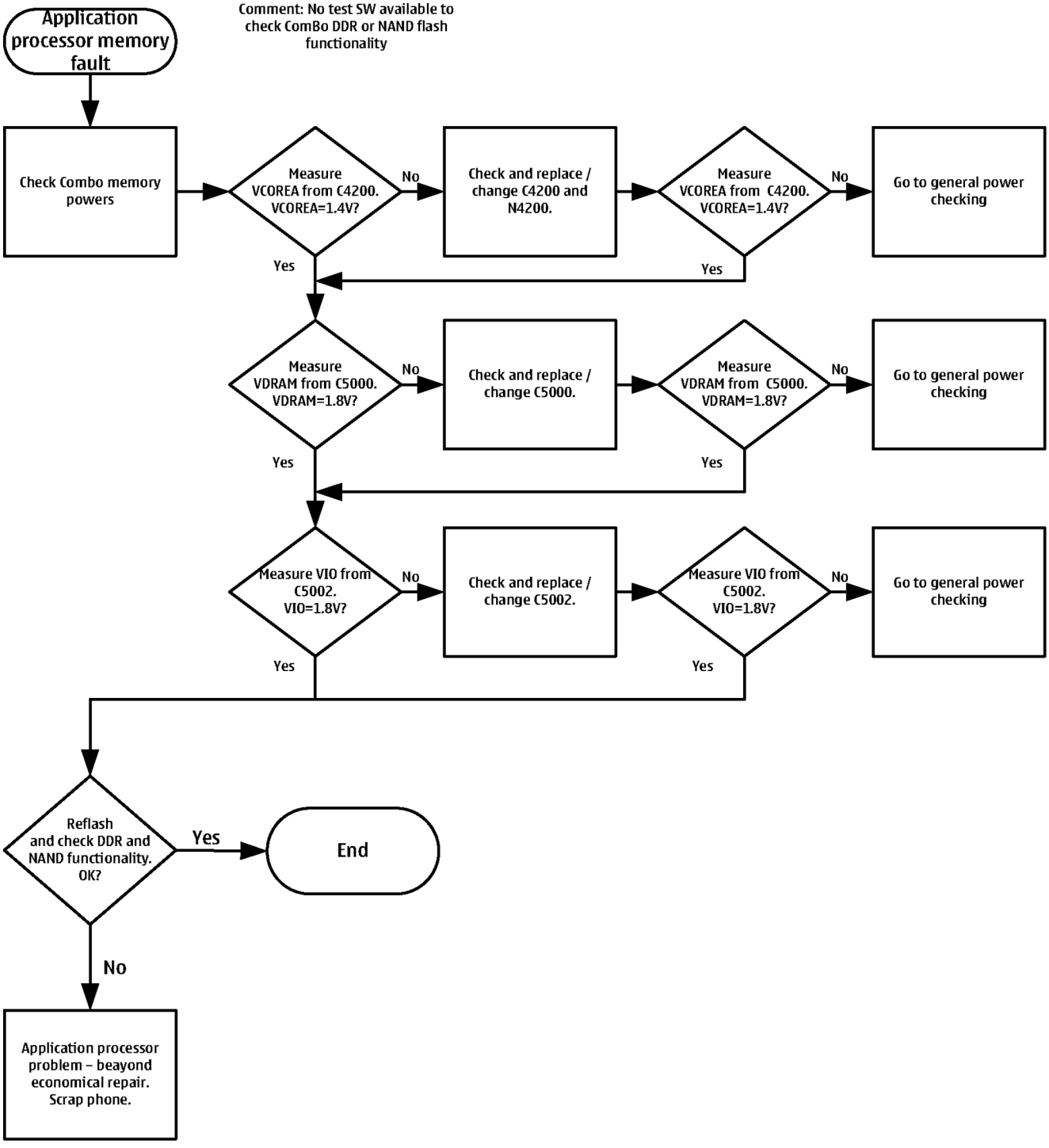
## Application processor memory troubleshooting

### Troubleshooting flow




Note: It is not possible to change the application processor and combo. In this case, the PWB is beyond economical repair.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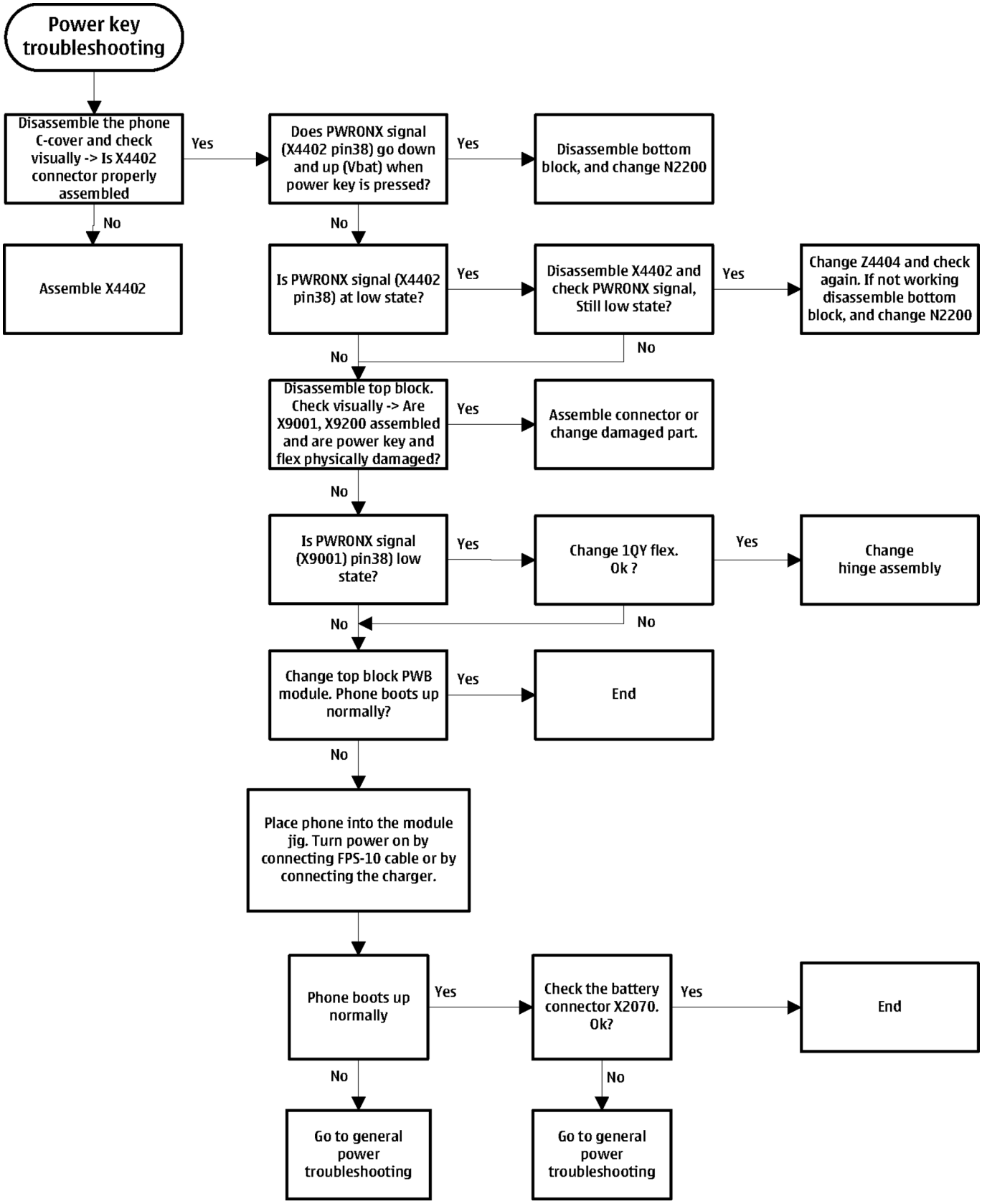
## Power key troubleshooting

### Troubleshooting flow





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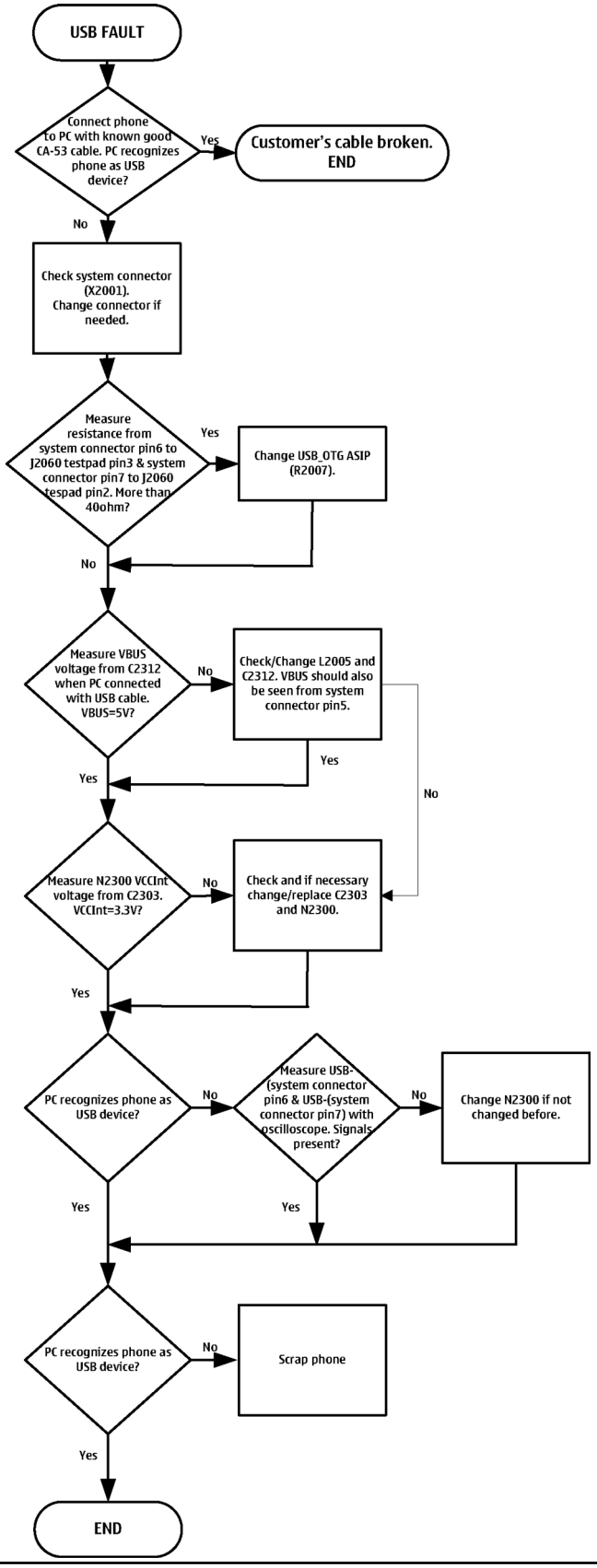
## USB interface troubleshooting

### Troubleshooting flow





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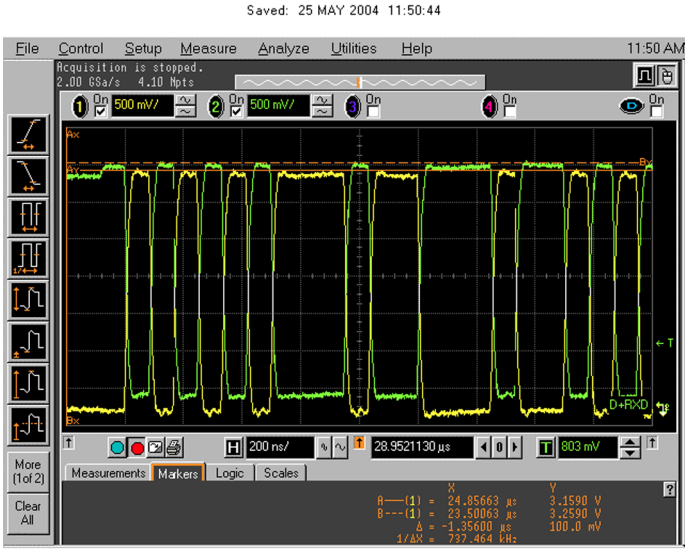


**Figure 39 USB 1: D-TXD (system connector pin6) and D+RXD (system connector pin7) voltage levels when USB connected.**


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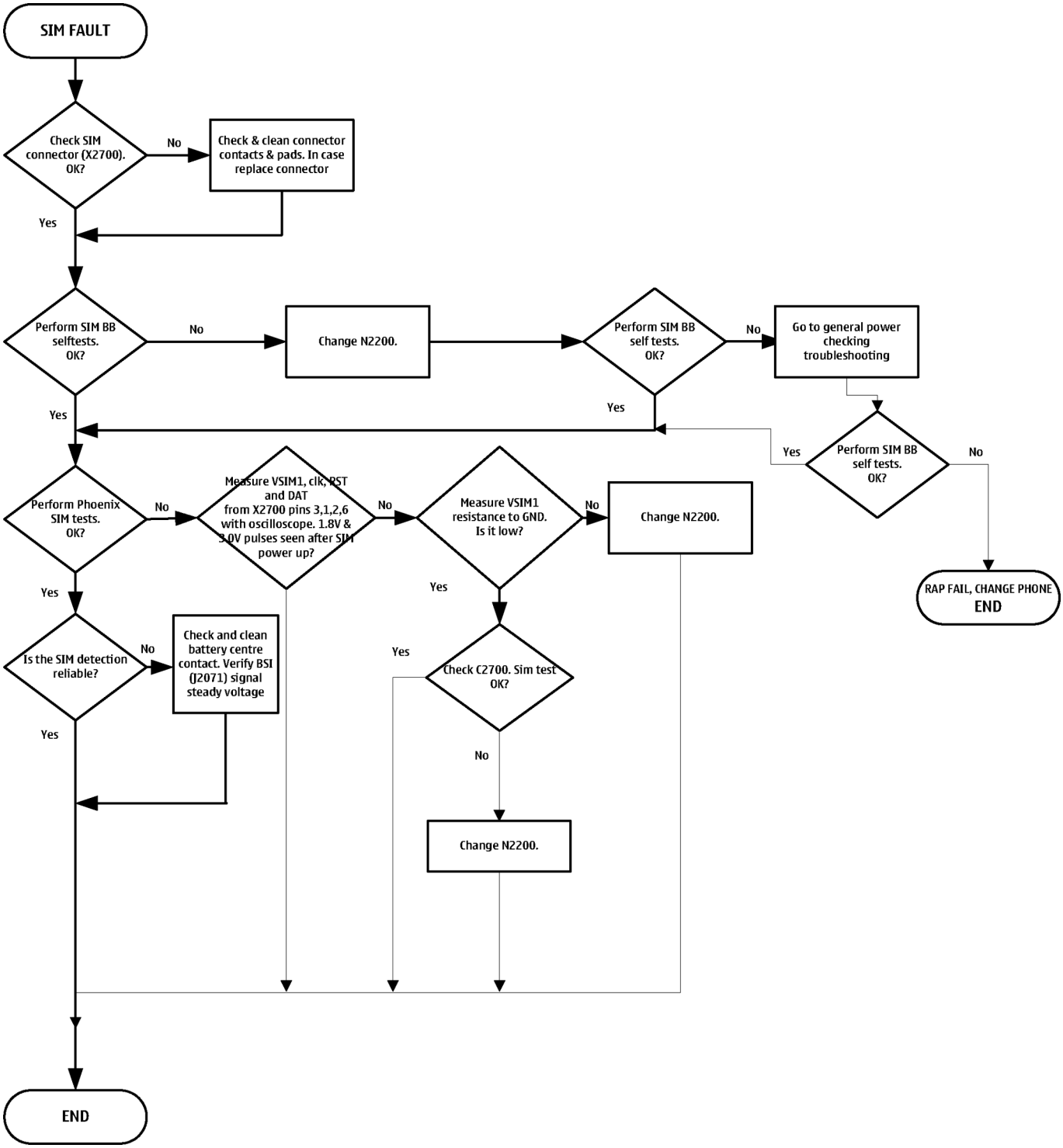
## SIM card troubleshooting

### Troubleshooting flow





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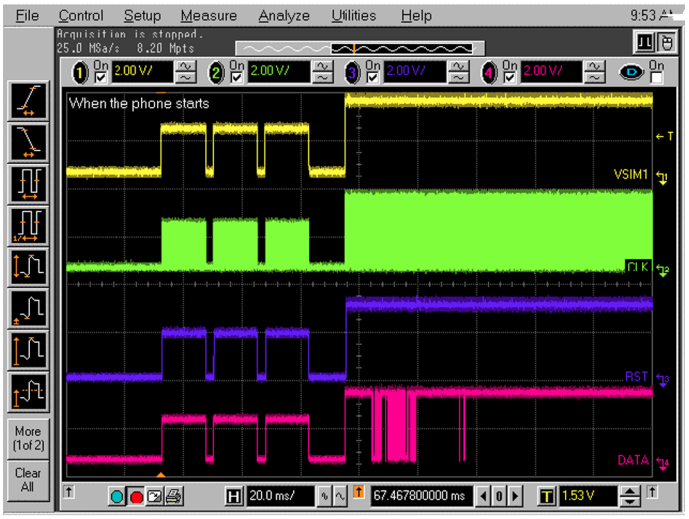


SIM CLK frequency = 3.2MHz (Take single triggered measurement in boot on the VSIM1 line).

**Figure 40 SIM interface signals**


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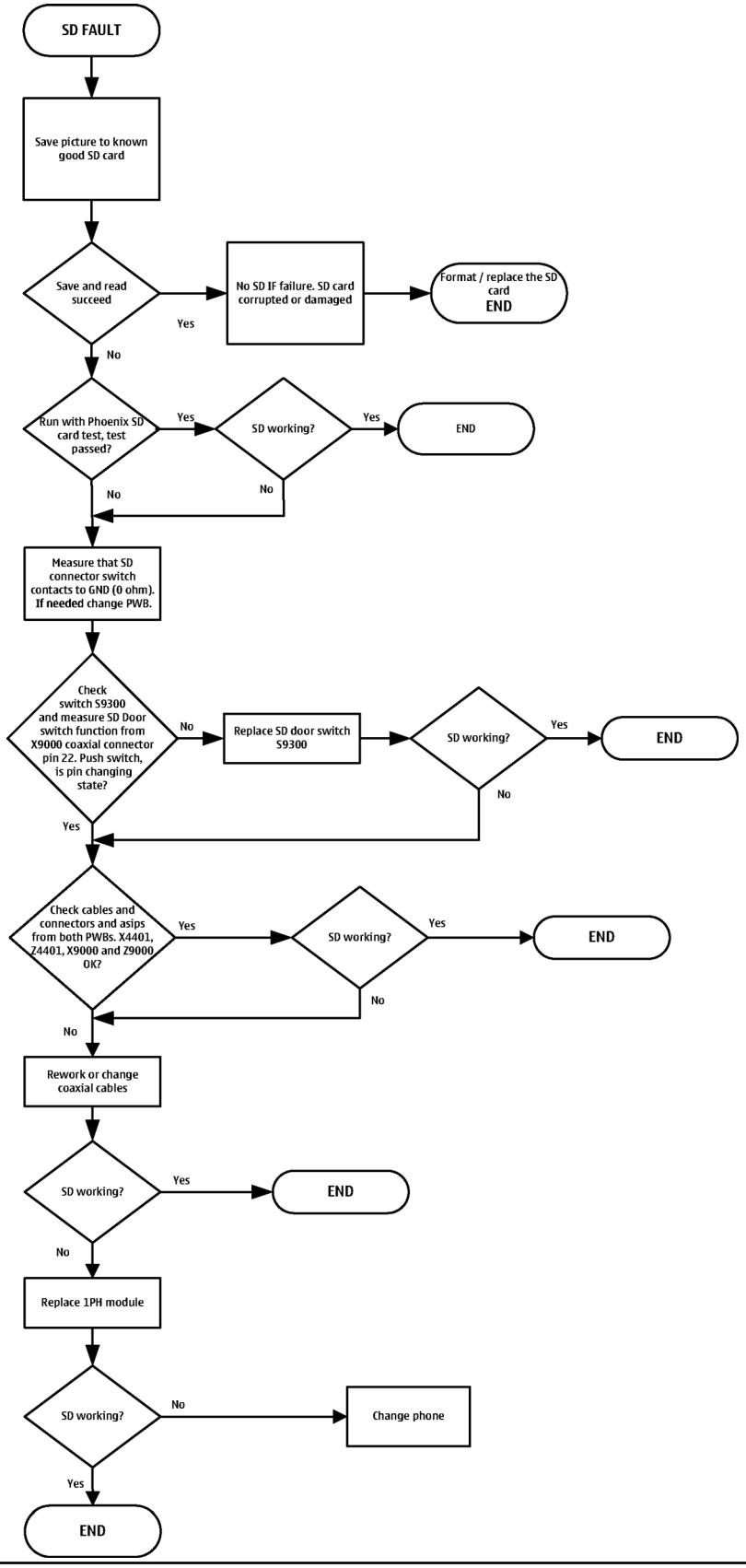
## SD card troubleshooting

### Troubleshooting flow





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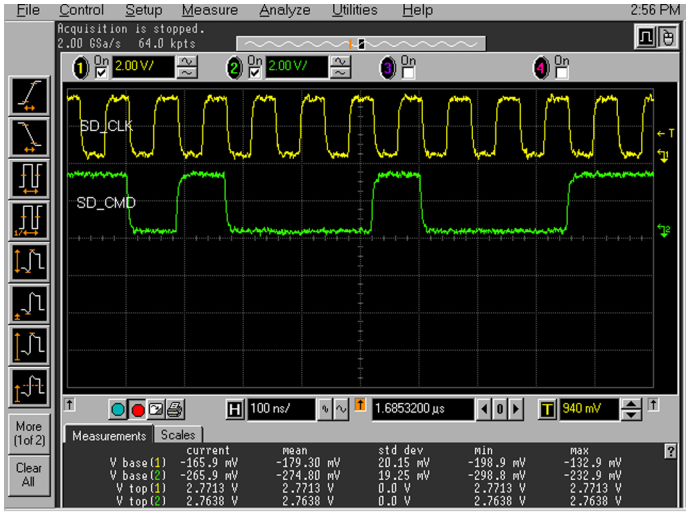


**Figure 41 SD_clk-cmd_voltage-base-top**

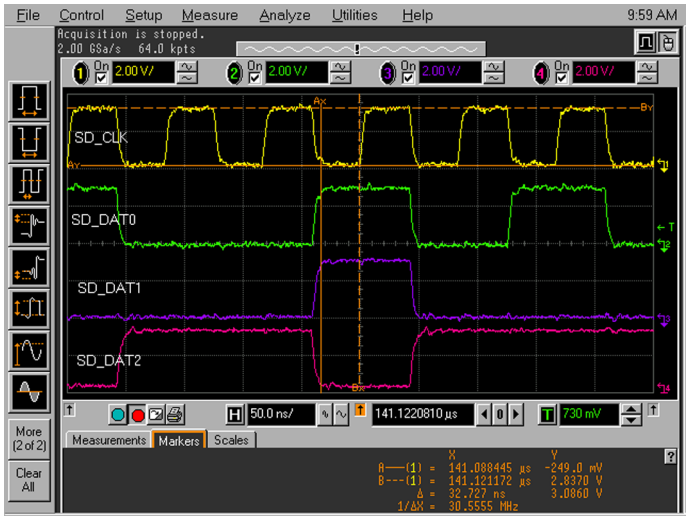


**Figure 42 SD_clk_data_tISU**

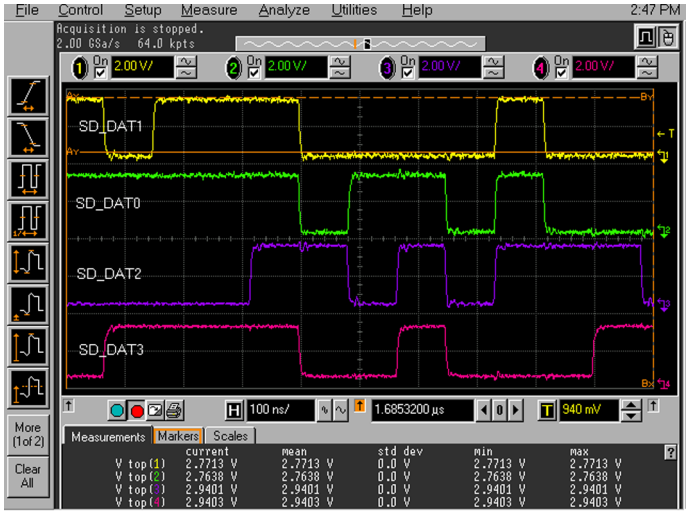


**Figure 43 SD_data_voltage-top**


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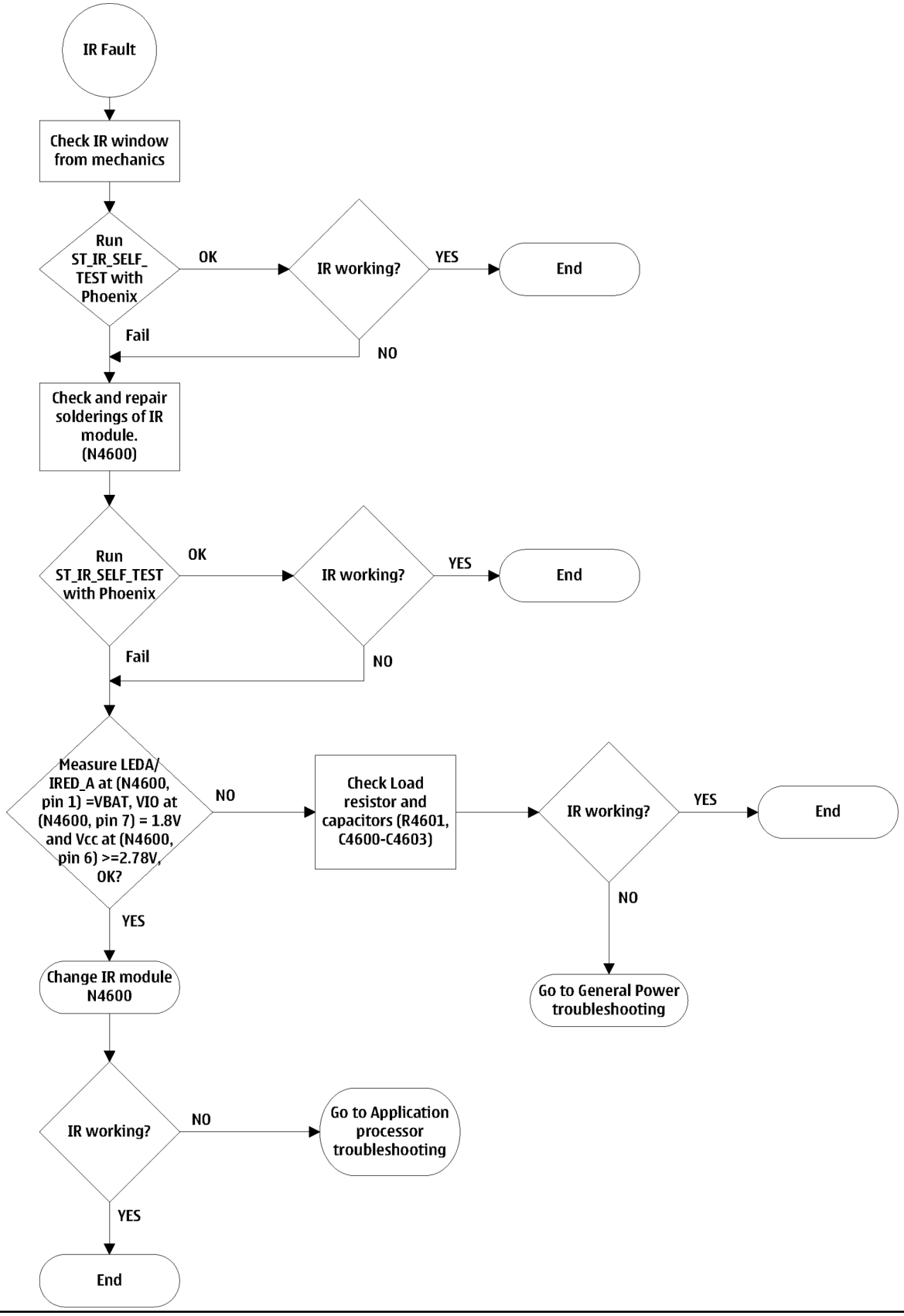
## IrDA troubleshooting

### Troubleshooting flow





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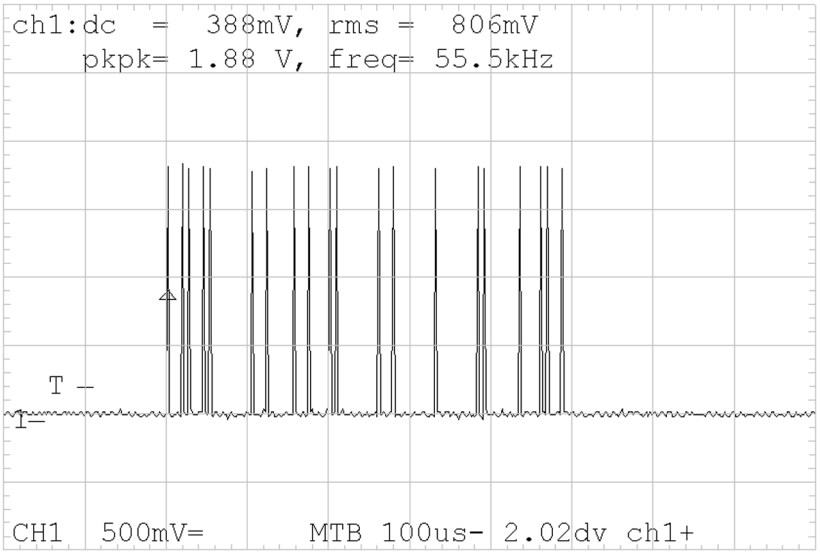


**Figure 44 IR TX diagram**

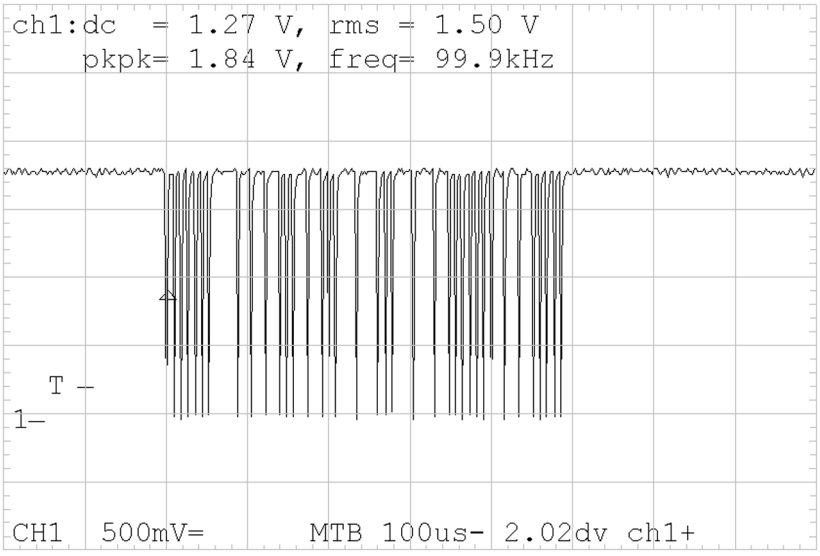


**Figure 45 IR RX diagram**


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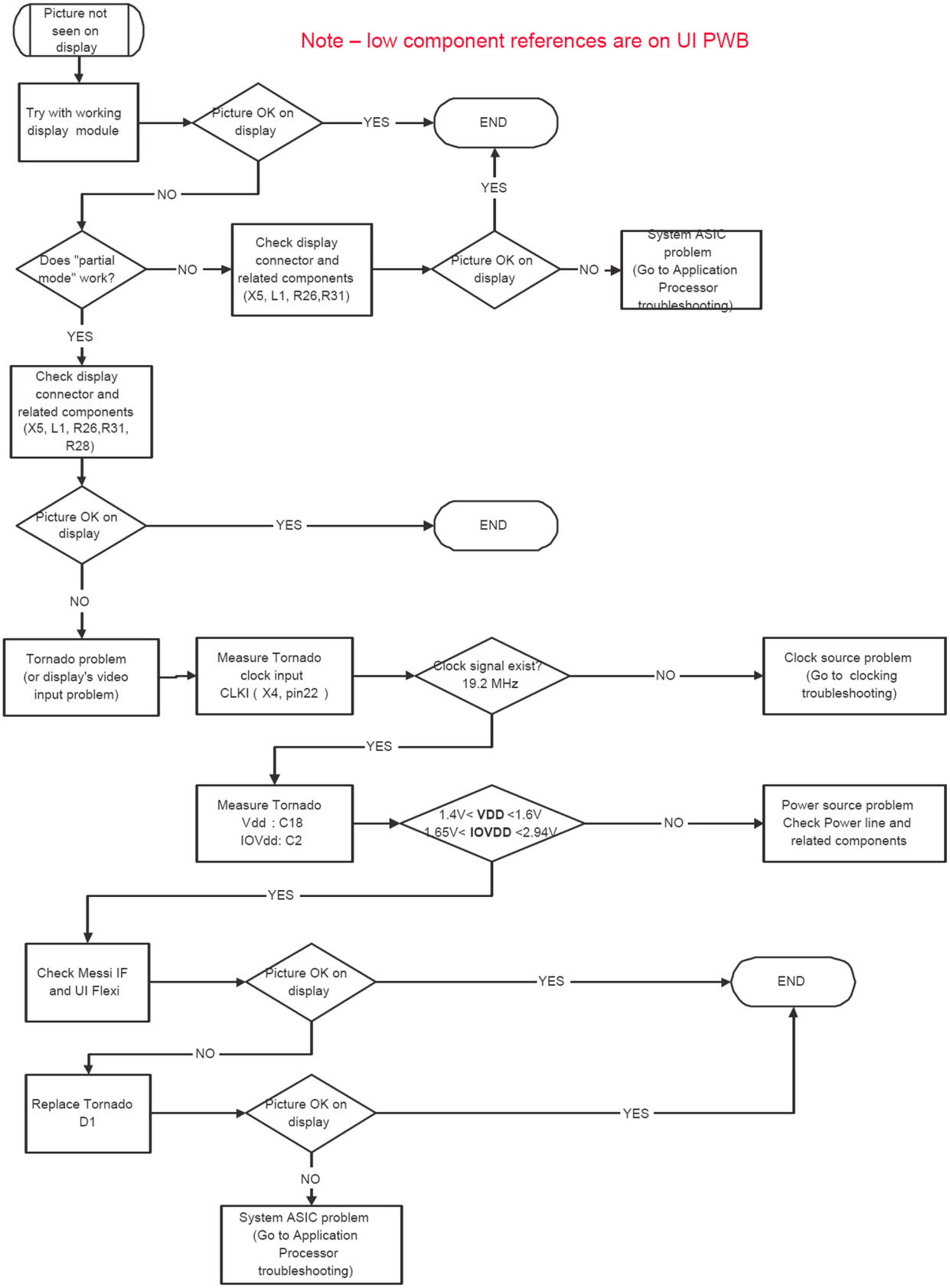
## Display controller troubleshooting

### Troubleshooting flow





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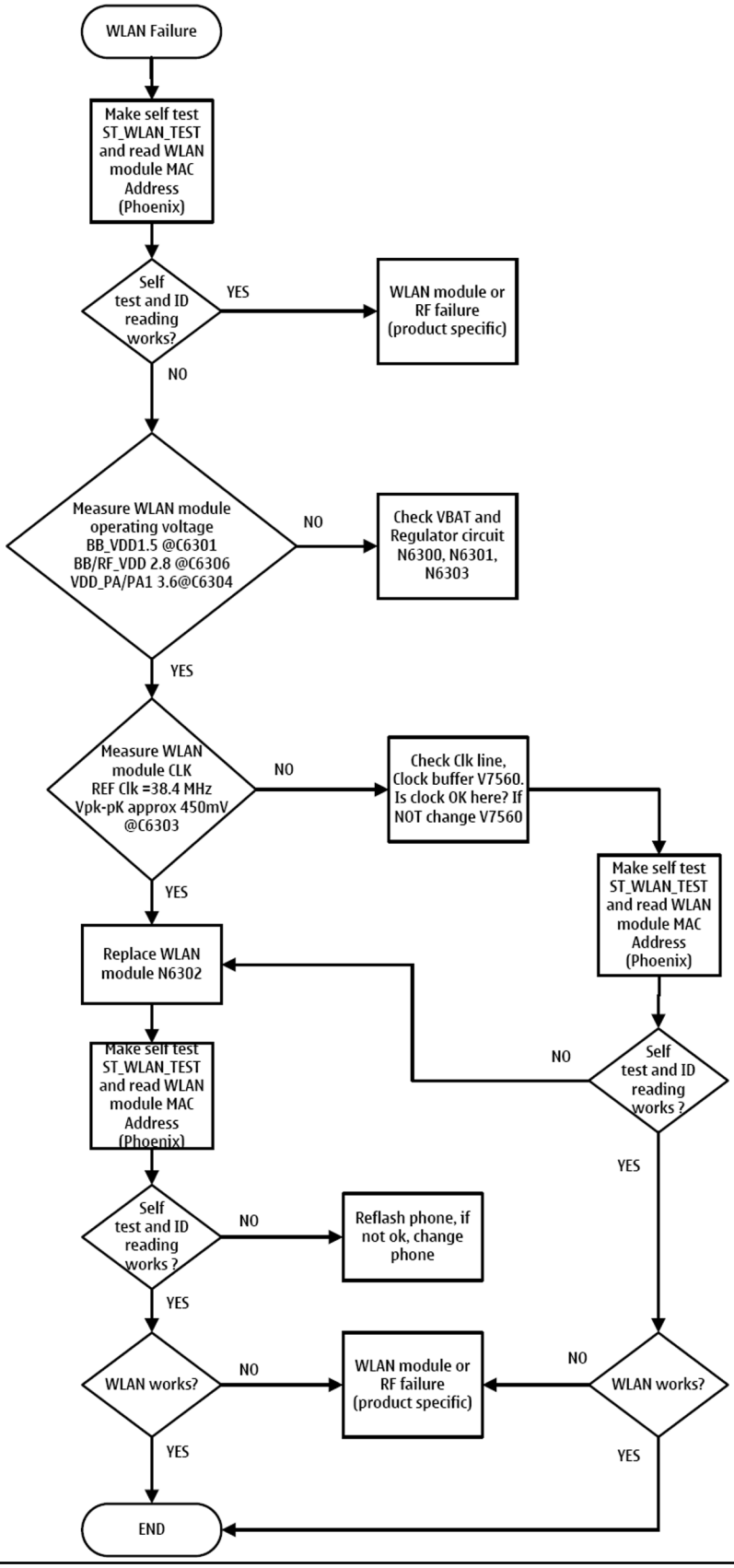
## WLAN interface troubleshooting

### Troubleshooting flow





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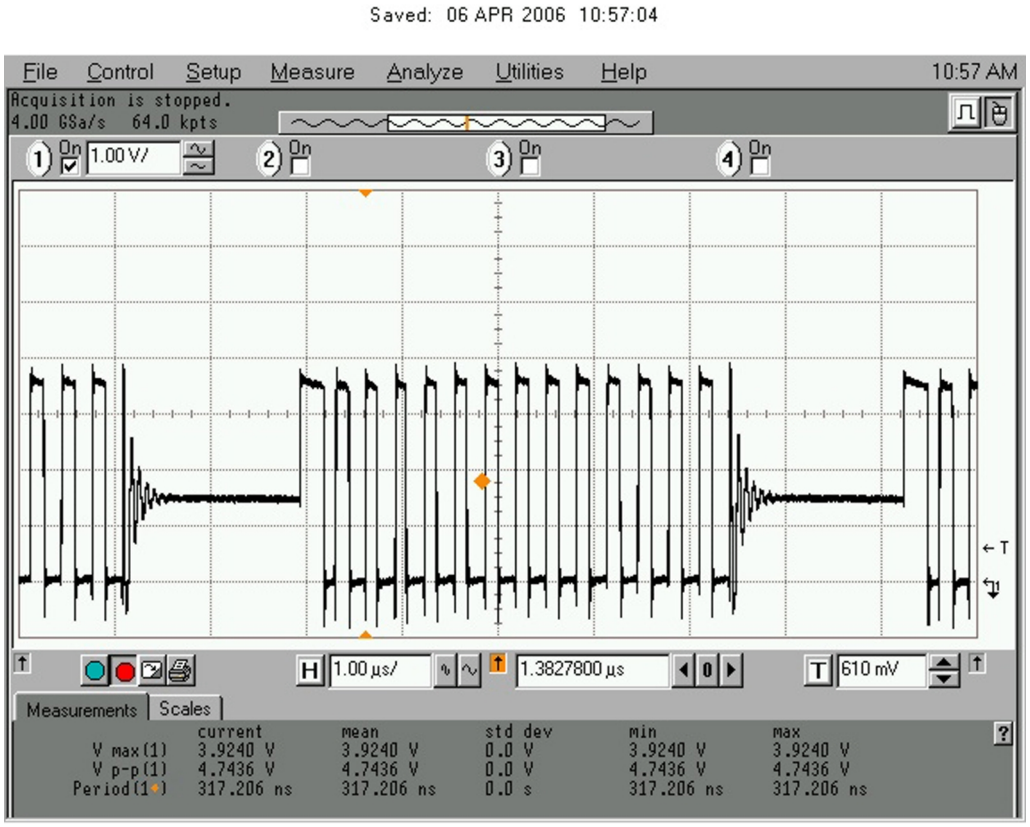


**Figure 46 L6300 Wlan SMPS coil**

## Keyboard troubleshooting

### Context

There are two possible failure modes in the keyboard module:

- One or more keys can be stuck, so that the key does not react when a keydome is pressed. This kind of failure is caused by mechanical reasons (dirt, corrosion).
- Malfunction of several keys at the same time; this happens when one or more rows or columns are failing (shortcut or open connection). For a more detailed description of the keyboard and keymatrix, see section **Keyboard**.

If the failure mode is not clear, start with the **Keyboard Test** in *Phoenix*.


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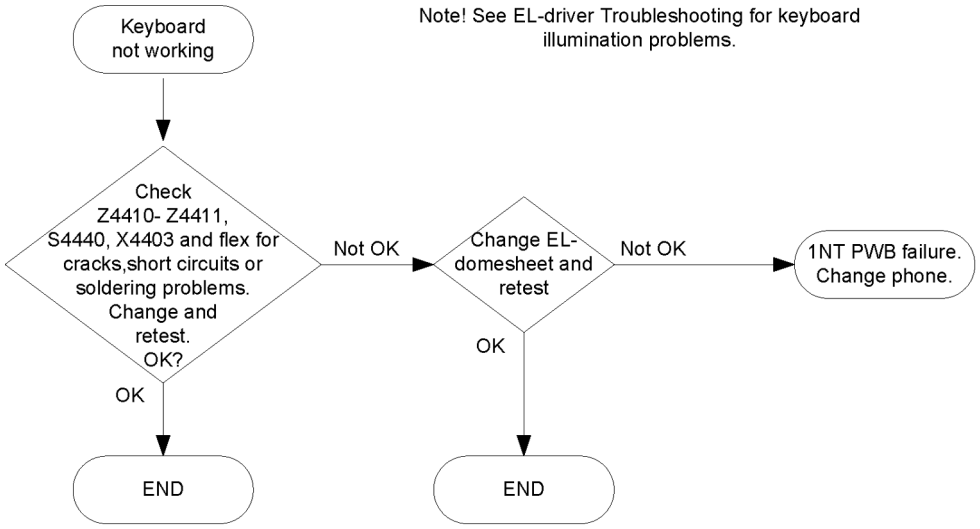
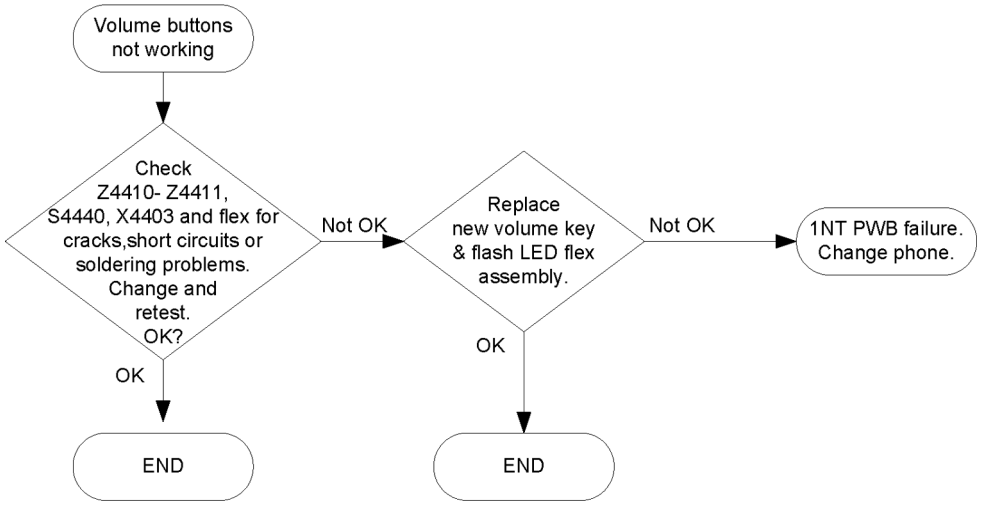
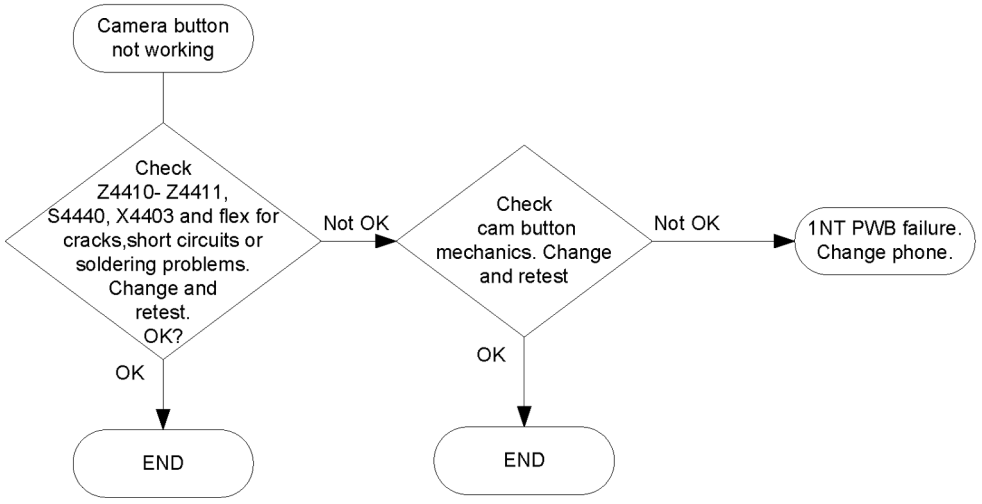
## Troubleshooting flow





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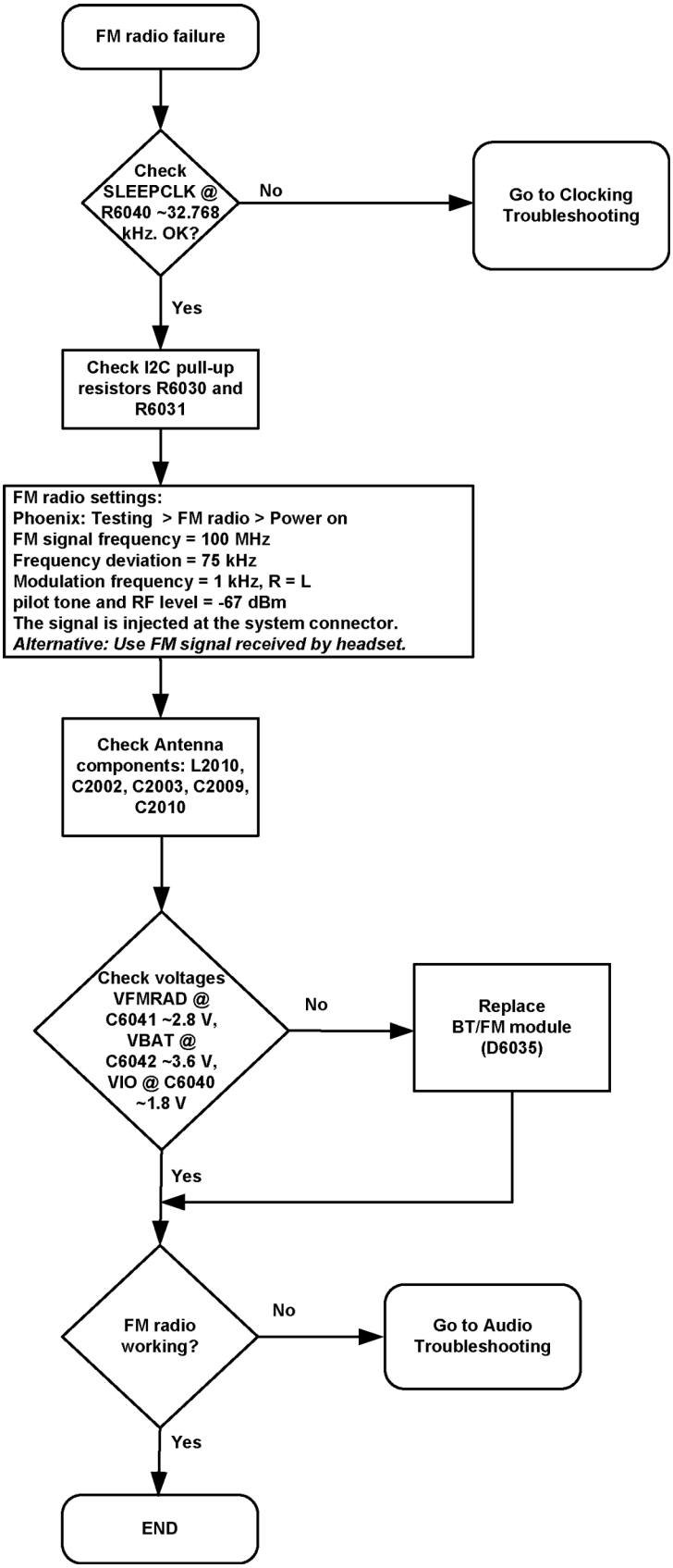
## FM radio troubleshooting

### Troubleshooting flow





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## Certificate restoring for BB5 products

### Context

This procedure is performed when the device certificate is corrupted for some reason.

All tunings (RF & Baseband, UI) must be done after performing the certificate restoring procedure.

The procedure for certificate restoring is the following:

- Flash the phone with the latest available software using FPS-8 or FPS-10.

  **Note:** USB flashing does not work for a dead BB5 phone.
- Create a request file.
- Send the file to Nokia by e-mail. Use the following addresses depending on your location:
  - APAC: sydney.service@nokia.com
  - CHINA: repair.ams@nokia.com
  - E&A: salo.repair@nokia.com
  - AMERICAS: fls1.usa@nokia.com
- When you receive a reply from Nokia, carry out certificate restoring.
- Tune the phone completely.

  **Note:** SX-4 smart card is needed.
- If the phone resets after certificate restoring, reflash the phone again.

Required equipment and setup:

- *Phoenix* service software v 2004.39.7.70 or newer.
- The latest phone model specific *Phoenix* data package.
- PKD-1 dongle
- SX-4 smart card (Enables BB5 testing and tuning features)
- External smart card reader

  **Note:** The smart card reader is only needed when FPS-8 is used. FPS-10 has an integrated smart card reader.
- Activated FPS-8 flash prommer **OR** FPS-10 flash prommer
- Flash update package 03.18.004 or newer for FPS-8 or FPS-10 flash prommers
- CU-4 control unit
- USB cable from PC USB Port to CU-4 control unit
- Phone model specific adapter for CU-4 control unit
- PCS-1 cable to power CU-4 from external power supply
- XCS-4 modular cable between flash prommer and CU-4

  **Note:** CU-4 must be supplied with +12 V from an external power supply in all steps of certificate restoring.

### Steps

1. Program the phone software.
   i Start *Phoenix* and login. Make sure the connection has been managed correctly for FPS-8 or FPS-10.
   ii Update the phone MCU software to the latest available version.
   If the new flash is empty and the phone cannot communicate with *Phoenix*, reflash the phone.


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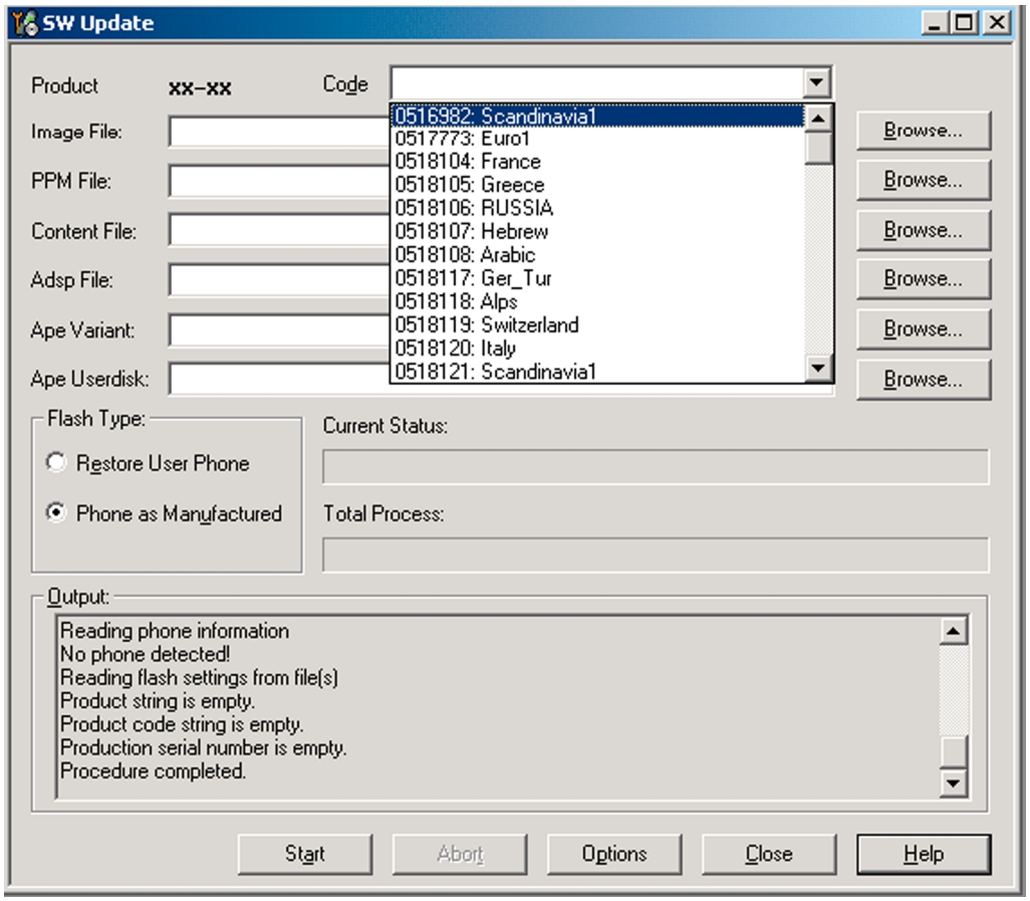
iii Choose the product manually from **File→Open Product** , and click **OK**.

Wait for the phone type designator (e.g. "RM-1" ) to be displayed in the status bar.

iv Go to **Flashing→SW Update** and wait until *Phoenix* reads the product data as shown in the following picture.




| | |
|---|---|
| **Product** | is automatically set according to the phone support module which was opened manually, but the flash files cannot be found because the correct data cannot be read from the phone automatically. |
| **Code** | must be chosen manually, it determines the correct flash files to be used. Please choose the correct product code (can be seen in the phone type label) from the dropdown list. |
| **Flash Type** | must be set to **Phone as Manufactured**. |

v To continue, click **Start**.

Progress bars and messages on the screen show actions during phone programming, please wait.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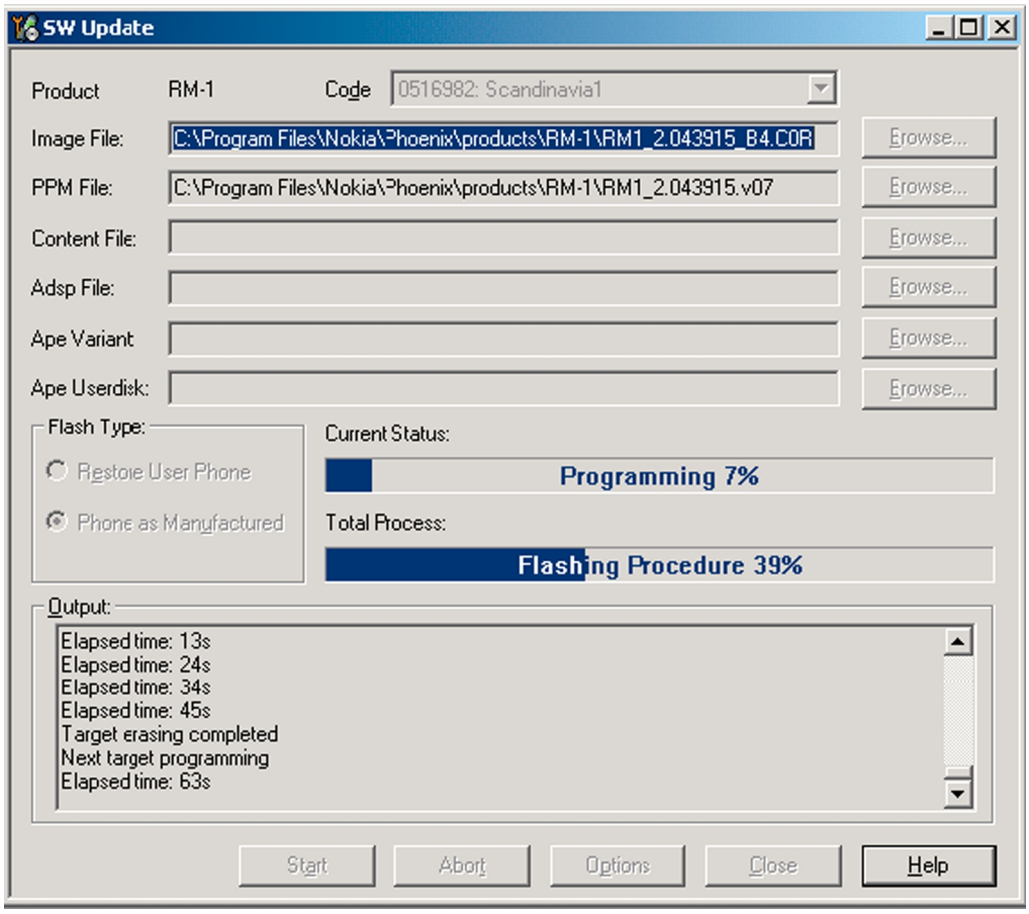



Programming is completed when *Flashing Completed* message is displayed.

The product type designator and MCU SW version are displayed in the status bar.

vi Close the *SW Update* window and then choose **File→Close Product** .

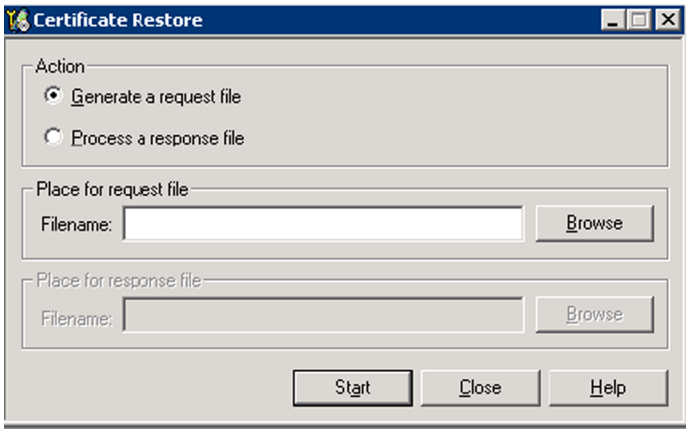
2. Create a *Request* file.

For this procedure, you must supply +12 V to CU-4 from an external power supply.

i To connect the phone with *Phoenix*, choose **File→Scan Product** .

ii Choose **Tools→Certificate Restore** .

iii To choose a location for the request file, click **Browse**.





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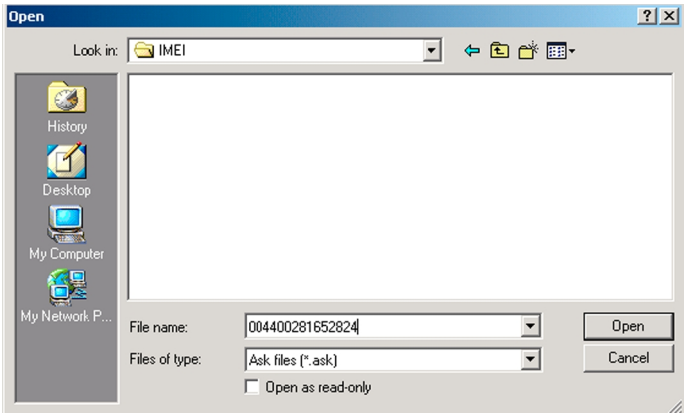
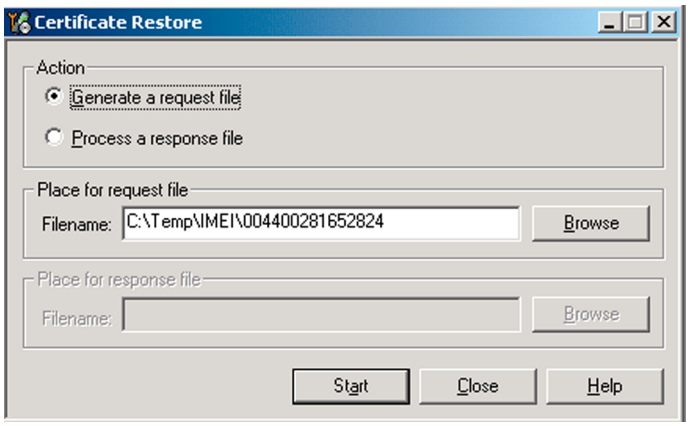
iv Name the file so that you can easily identify it, and click **Open**.




The name of the file and its location are shown.




v To create the *Request* file, click **Start**.

vi When the file for certificate restore has been created, send it to Nokia as an e-mail attachment.

3. Restore certificate.

For this procedure, you must supply +12 V to CU-4 from an external power supply.

i Save the reply file sent by Nokia to your computer.

ii Start *Phoenix* service software.

iii Choose **File→Scan Product** .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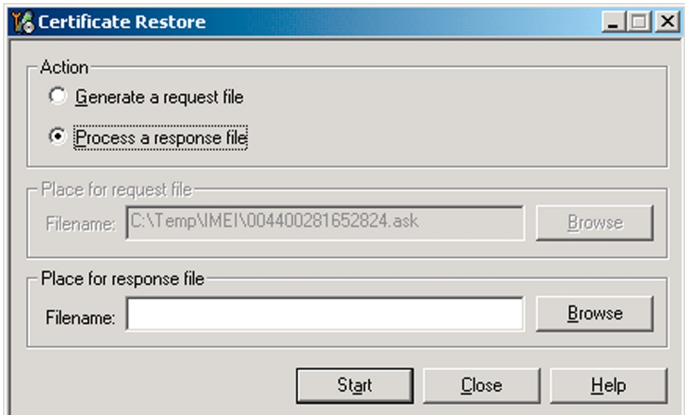
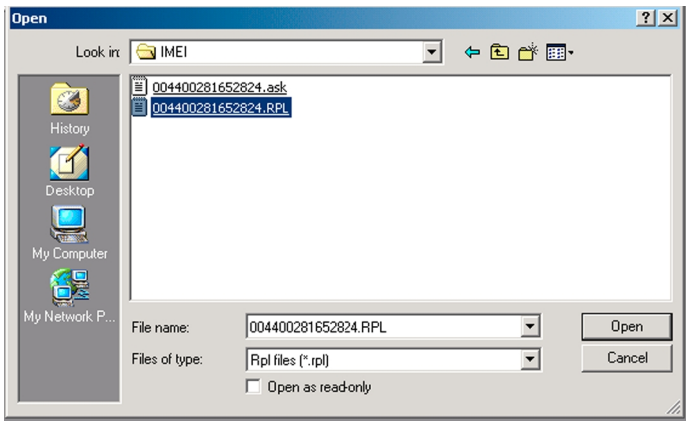
iv From the **Tools** menu, choose **Certificate Restore** and select **Process a response file** in the *Action* pane.



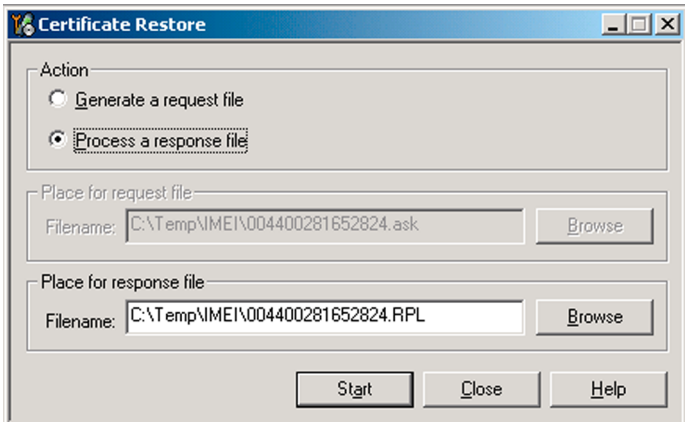

v To choose the location where response file is saved, click **Browse**.

vi Click **Open**.




The name of the file and the path where it is located are shown.

vii To write the file to phone, click **Start**.




## Next actions

After a successful rewrite, you must retune the phone completely by using *Phoenix* tuning functions.

**Important:** Perform all tunings: RF, BB, and UI.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# Display module troubleshooting

## General instructions for display troubleshooting

The first step is to verify that upper and lower block cables and display module connection are working. After that troubleshooting can go deeper. The display modules cannot be repaired.

The next step is to check that baseband engine and other display related circuits are working normally. This can be done by connecting the phone to a docking station and starting Phoenix service software. By running different selftests, component functionality can be checked. Follow the troubleshooting diagrams.

## Operating modes of the main display

Display is in a normal mode when the phone is in active use.

Display is in a partial idle mode when the phone is in the screen saver mode.

**Table 10 Display module troubleshooting cases**

| | |
|---|---|
| Display is very dim but image is seen correctly in display. | Backlight LED components are inside the display module. Backlight failure can also be in the connector or in the backlight power source in the main engine of the phone. |
| Image on the display is not correct or no image at all while backlight seems to work. | Image on the display can be corrupted or part of the image can be missing. If part of image is missing change the display module. If the image is otherwise corrupted, follow the appropriate troubleshooting diagram. |

## Operating modes of the sub display

The display is in a normal mode when the phone is set to closed position, during incoming call/message or other information to user.

The display is set to sleep mode soon after new information is shown.

The sub display is operated via a serial interface. Troubleshooting covers the interface between the application processor and sub display.

## Visual defects (pixel)

Pixel defects can be checked by controlling the display with Phoenix. Use both colours, black and white, on a full screen. The display may have some random pixel defects that are acceptable for this type of display. The criteria when pixel defects are regarded as a display failure, resulting in a replacement of the display, are presented in table below.

**Table 11 Pixel defects**

<table>
<tr><th>Item</th><th></th><th colspan="4">White dot defect</th><th>Black dot defect</th><th>Total</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Defect counts</td><td>R</td><td>G</td><td>B</td><td>White Dot Total</td><td rowspan="2">1</td><td rowspan="2">1</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>2</td><td>Combined defect counts</td><td colspan="6">Not allowed.<br>Two single dot defects that are within 5 mm of each other should be interpreted as combined dot defect.</td></tr>
</table>


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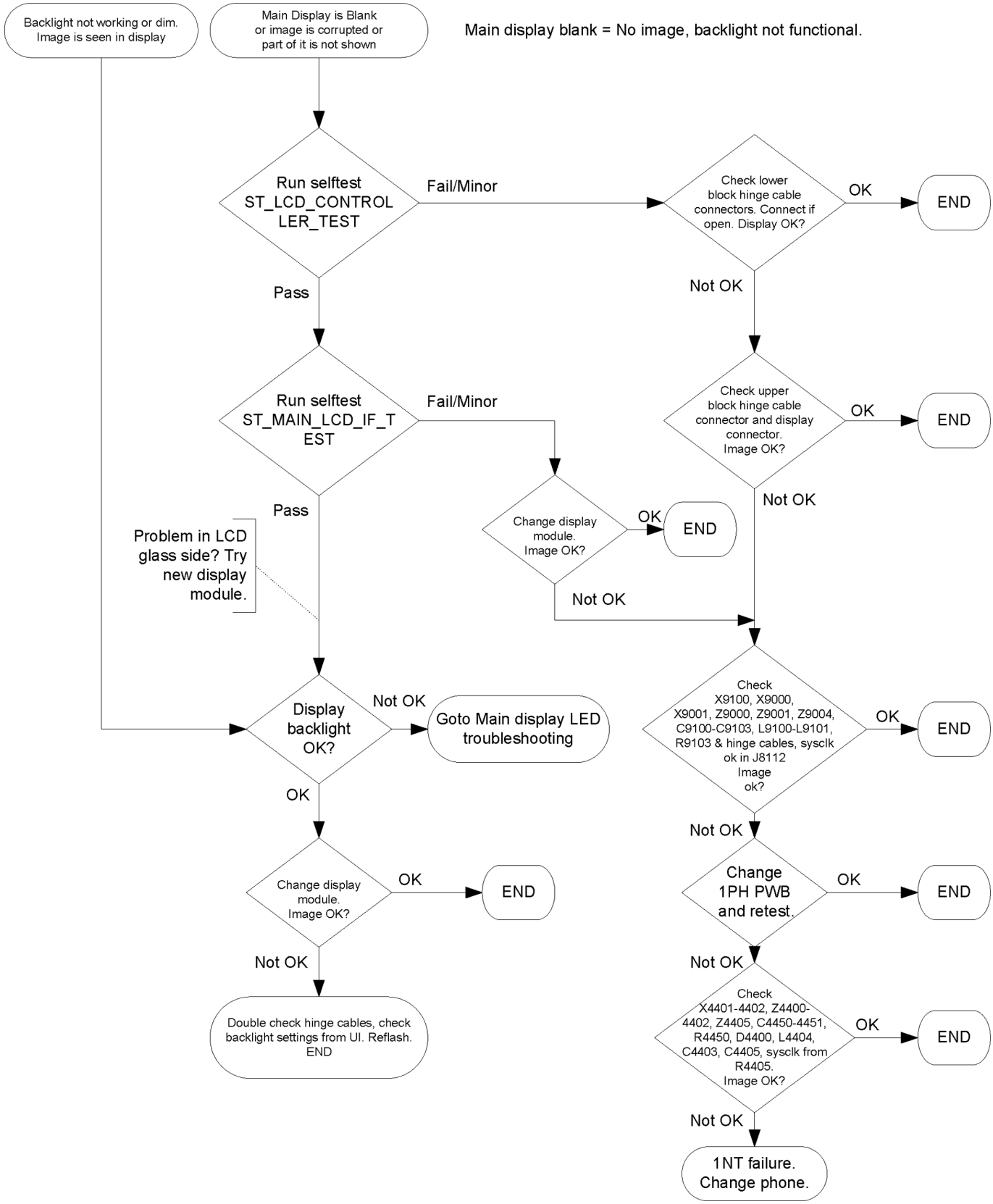
## Main display and graphics accelerator troubleshooting

### Troubleshooting flow





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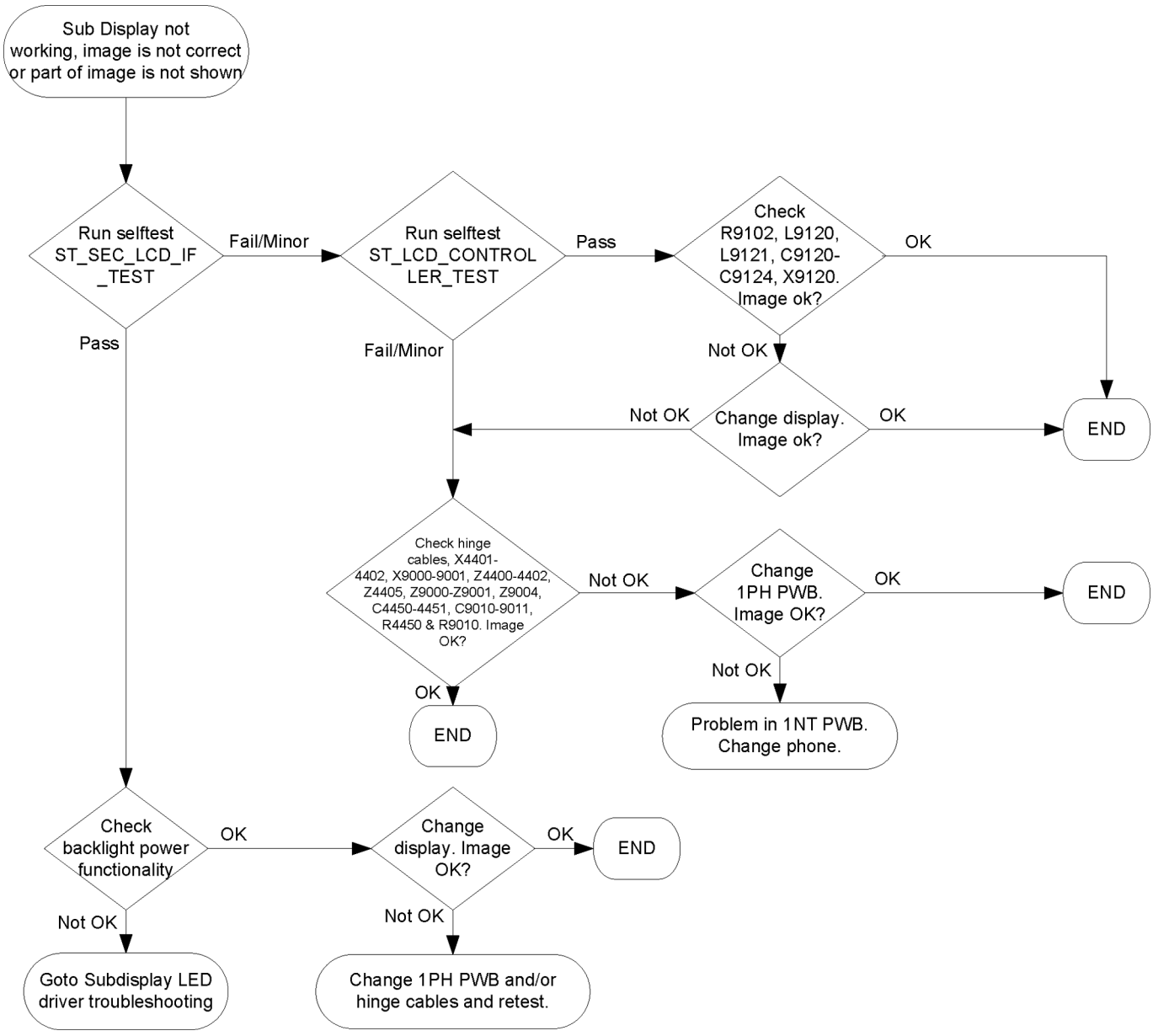
Test points:

J8112 & R4405 [Sysclk 19.2MHz, near sinewave, ~1.8Vpp]

## Sub display troubleshooting

### Troubleshooting flow





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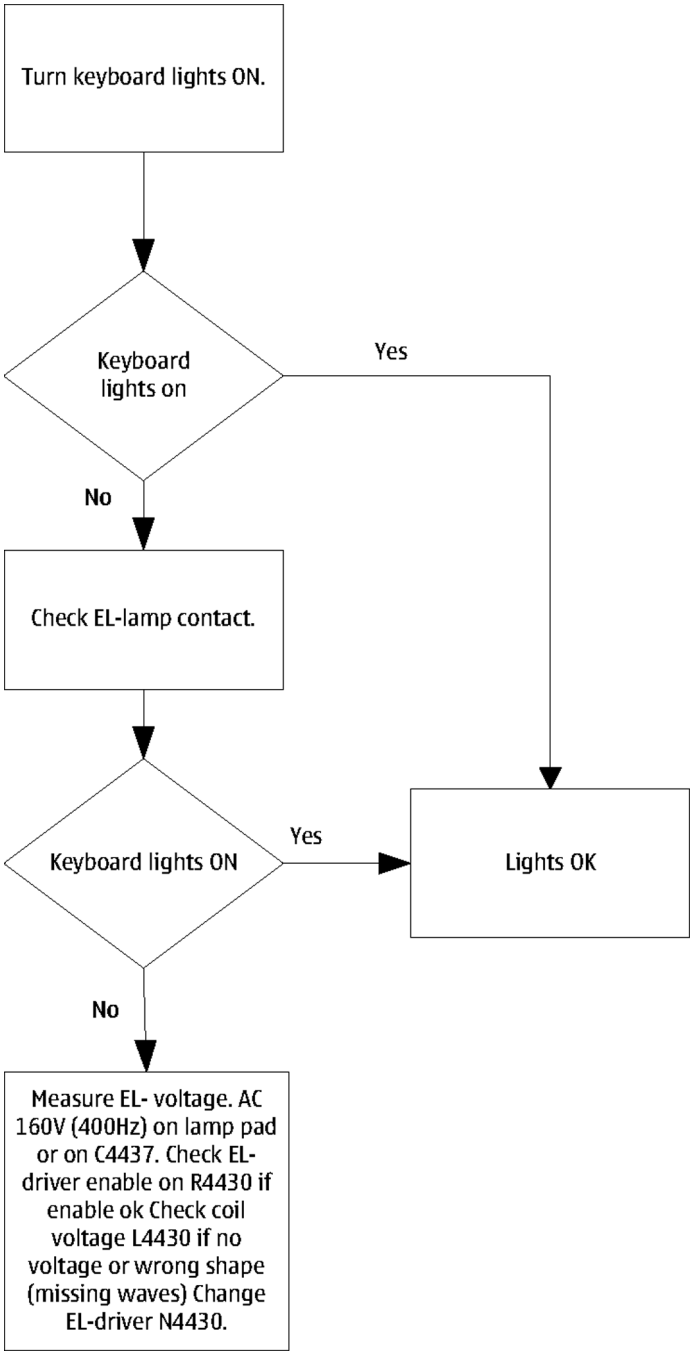
## Keyboard backlight troubleshooting

### Troubleshooting flow





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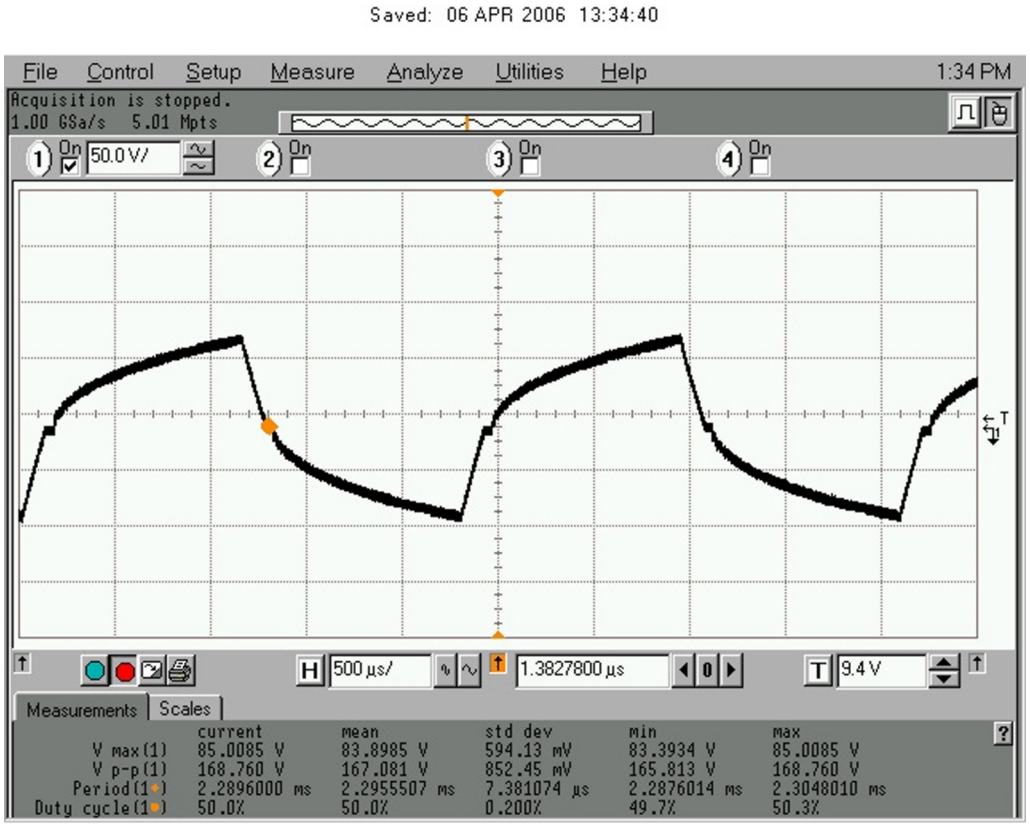


**Figure 47 C4437 or on_pad keyboard light voltage**

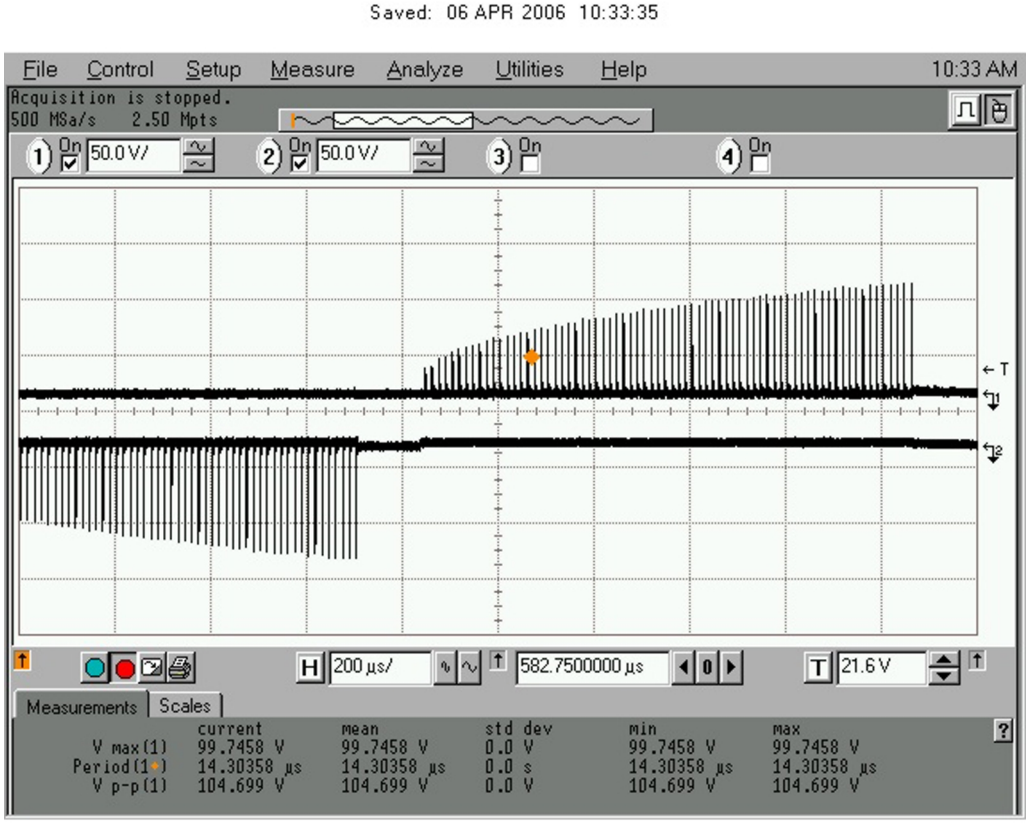


**Figure 48 L4430 Keyboard light SMPS coil**


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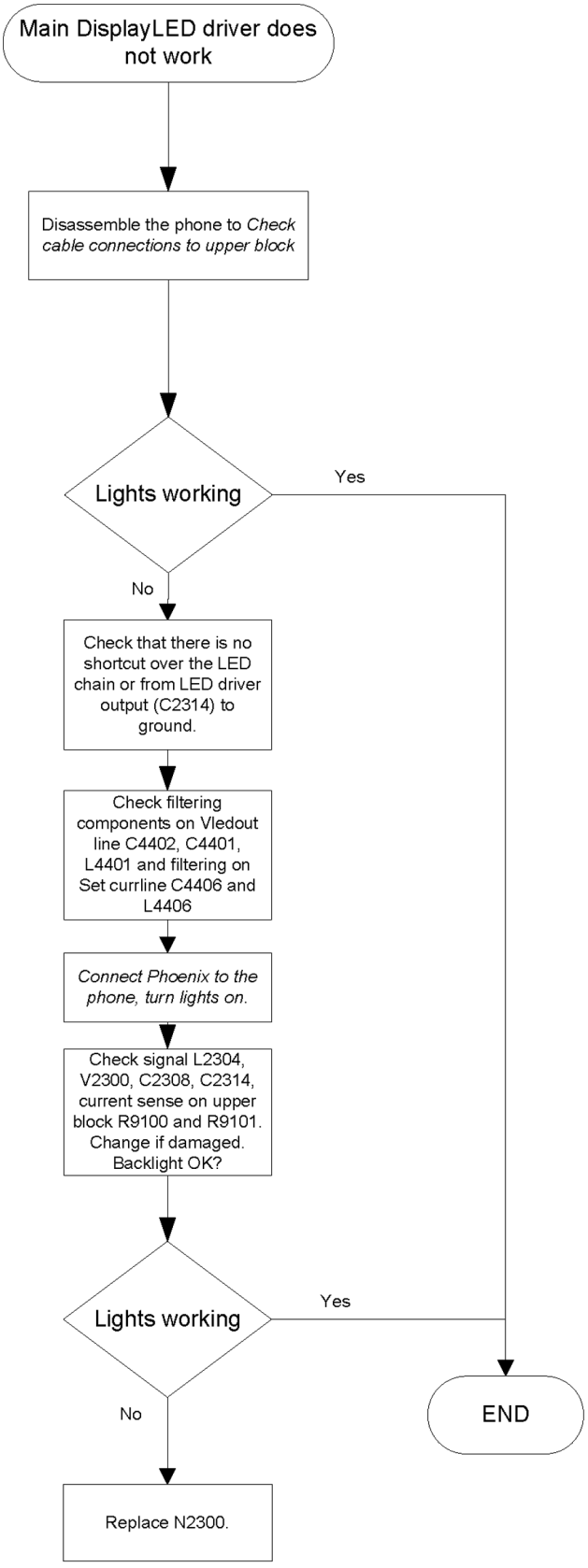
## Main display LED driver troubleshooting

### Troubleshooting flow





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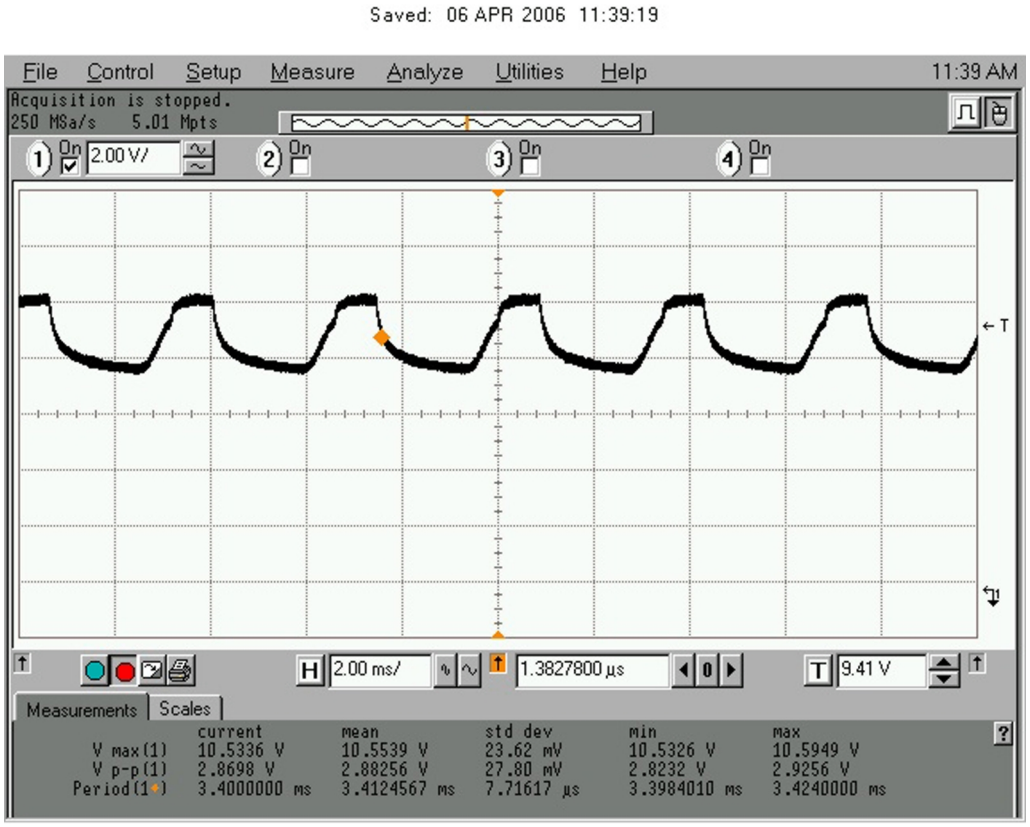


**Figure 49 C2314 main display light voltage**

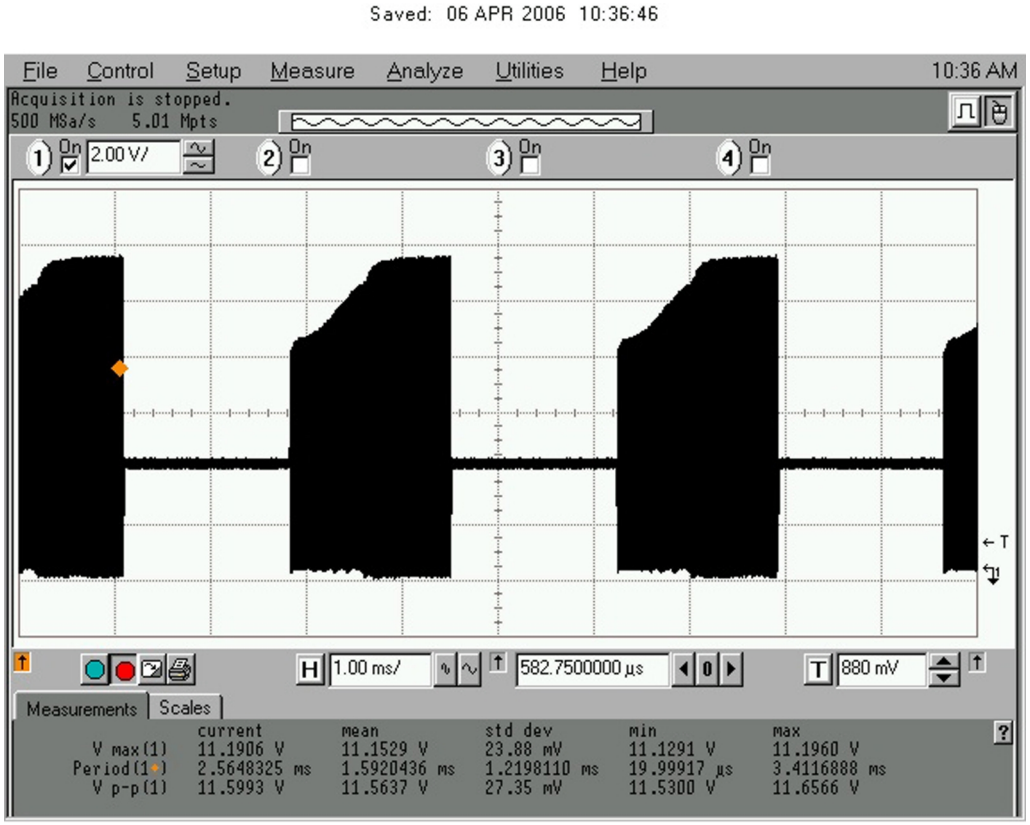


**Figure 50 L2304 main display light SMPS coil 50% light**


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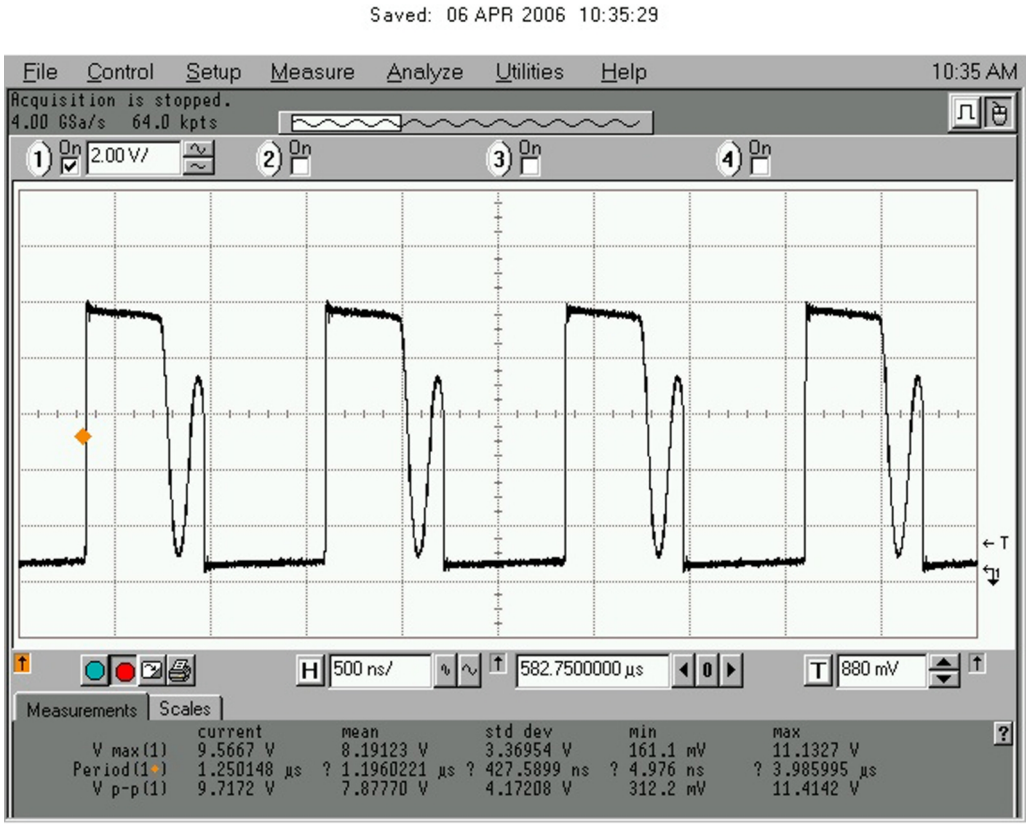


**Figure 51 L2304 main display light SMPS coil**


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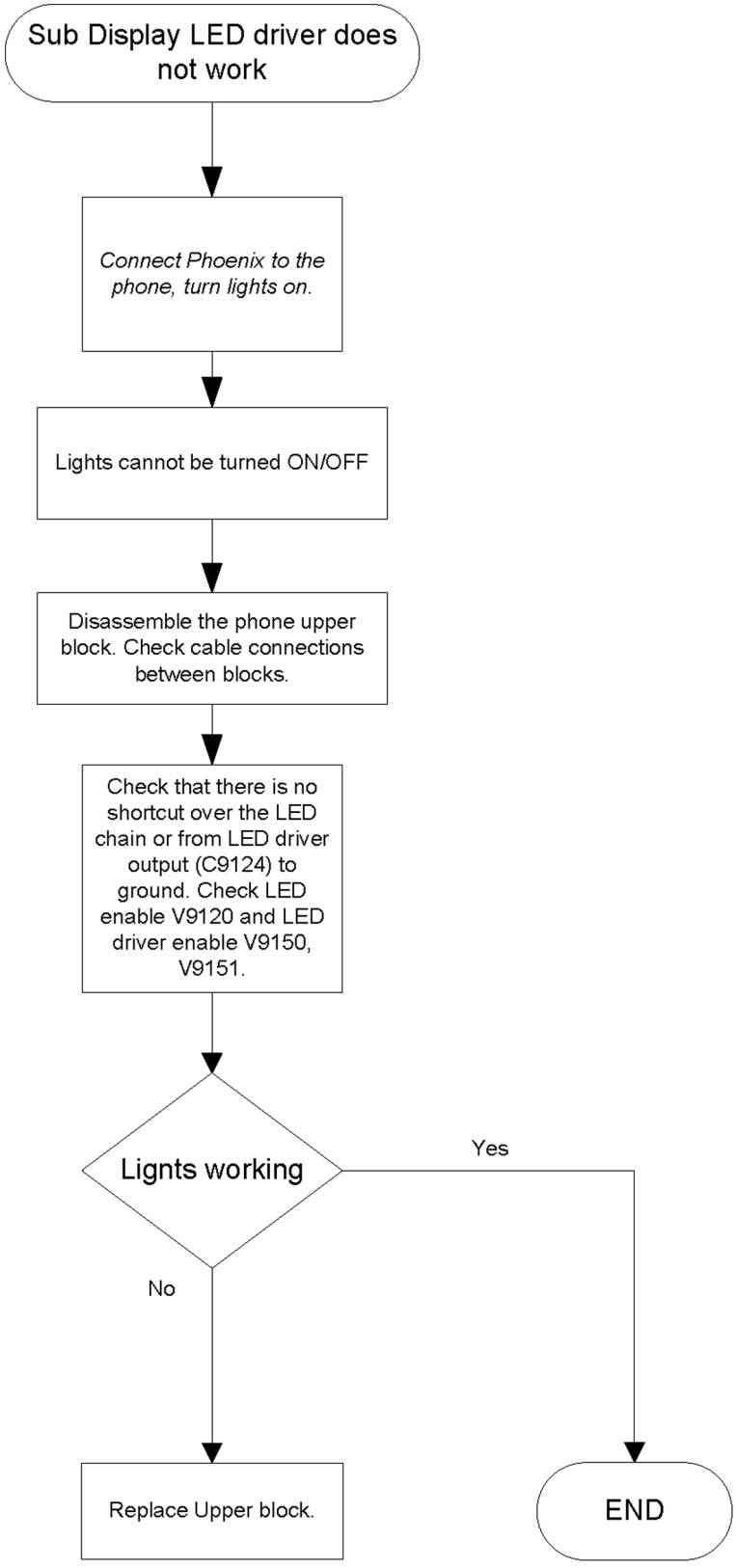
## Sub display LED driver troubleshooting

### Troubleshooting flow





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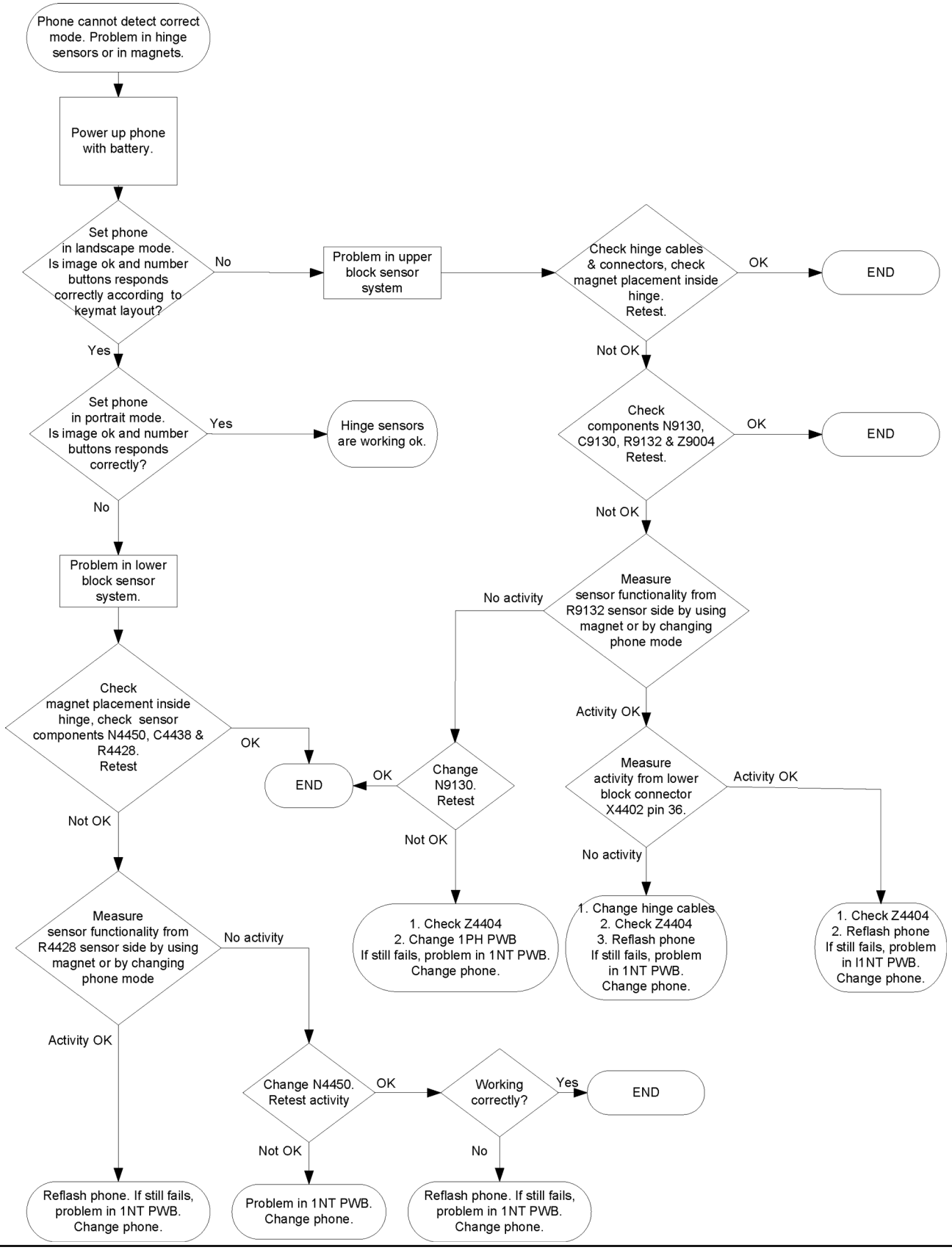
## Hinge sensor troubleshooting

### Troubleshooting flow





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Test points:

- R9132 (R9132 - N9130 connection) = X4402 pin 36 [1.8V IO voltage]
- R4428 (R4428 - N4450 connection) [1.8V IO voltage]

# Bluetooth troubleshooting

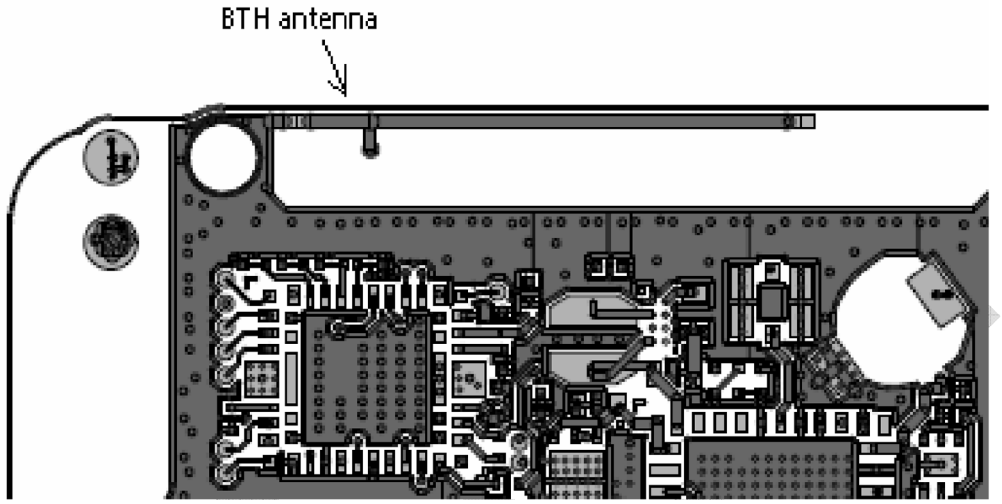
## Introduction to Bluetooth troubleshooting

There are two main Bluetooth problems that can occur:

| Problem | Description |
|---|---|
| BT antenna damage. | Bluetooth antenna is located in the edge of the PWB and it can be damaged when phone is dropped. |
| A malfunction in the BT ASIC, BB ASICs or Phone's BT SMD components. | This is unpredictable and could have many causes i.e. SW or HW related. |

The main issue is to find out if the problem is related to the BT antenna or the BT system or the phone's BB and then replace/fix the faulty component.

## Location of the BT antenna




## Bluetooth settings for Phoenix

### Steps

1. Start *Phoenix* service software.
2. From the **File** menu, choose **Open Product**, and then choose the correct type designator from the **Product** list.
3. Place the phone to a flash adapter in the local mode.
4. Choose **Testing→Bluetooth LOCALS** .
5. Locate JBT-9's serial number (12 digits) found in the type label on the back of JBT-9.

   In addition to JBT-9, also SB-6, JBT-3 and JBT-6 Bluetooth test boxes can be used.
6. In the *Bluetooth LOCALS* window, write the 12-digit serial number on the **Counterpart BT Device Address** line.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This needs to be done only once provided that JBT-9 is not changed.

7. Place the JBT-9 box near (within 10 cm) the BT antenna and click **Run BER Test**.

## Results

Bit Error Rate test result is displayed in the *Bit Error Rate (BER) Tests* pane in the *Bluetooth LOCALS* window.

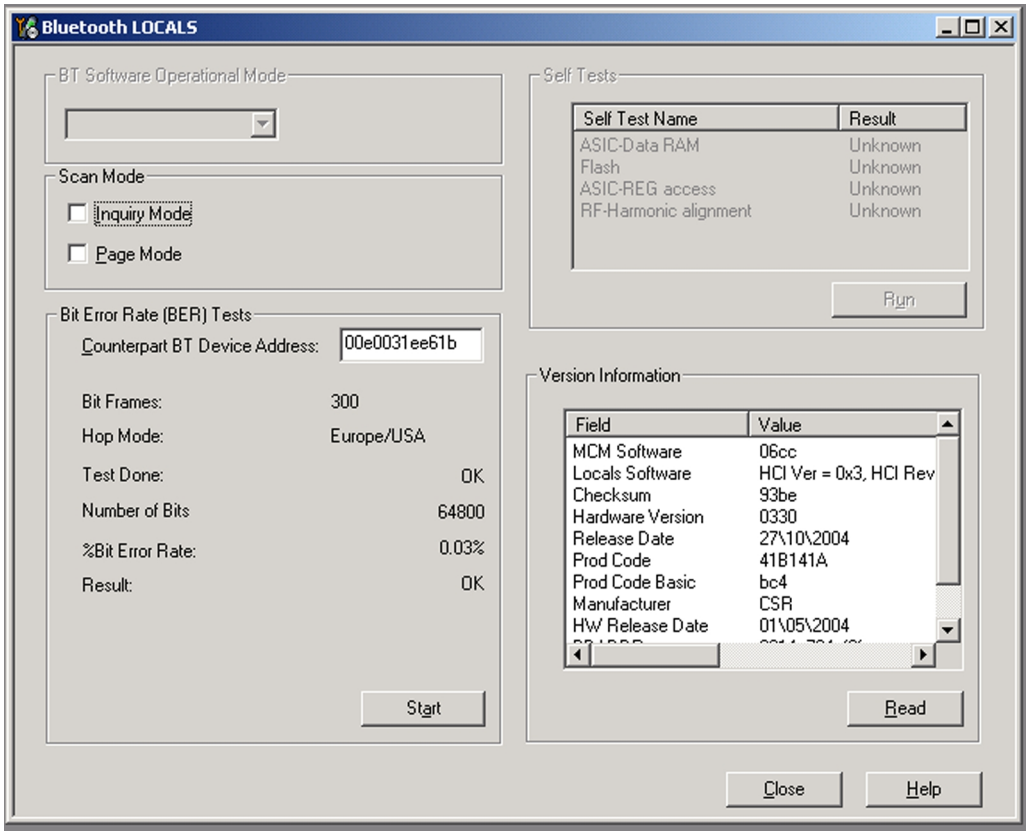


**Figure 52 BER test result**

## Bluetooth self tests in Phoenix

## Steps

1. Start *Phoenix* service software.
2. Choose**File→Scan Product.**
3. Place the phone to a flash adapter.
4. From the **Mode** drop-down menu, set mode to **Local**.
5. Choose **Testing→Self Tests.**
6. In the *Self Tests* window check the following Bluetooth related tests:
   - **ST_LPRF_IF_TEST**
   - **ST_LPRF_AUDIO_LINES_TEST**
   - **ST_BT_WAKEUP_TEST**


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7. To run the tests, click **Start**.

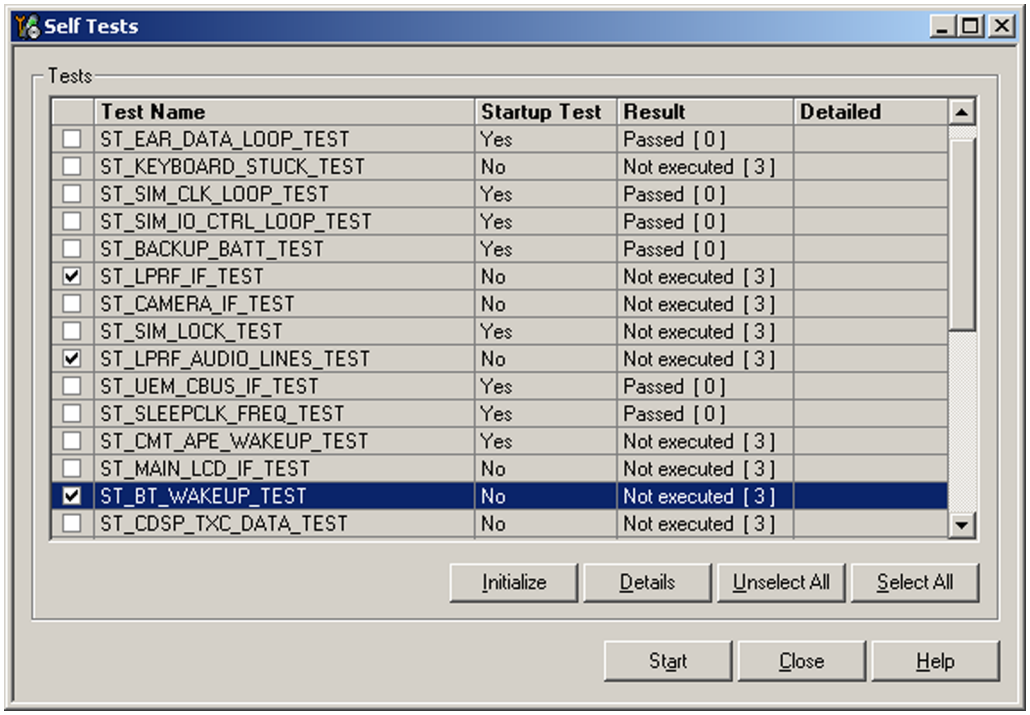


**Figure 53 Bluetooth self tests in *Phoenix***


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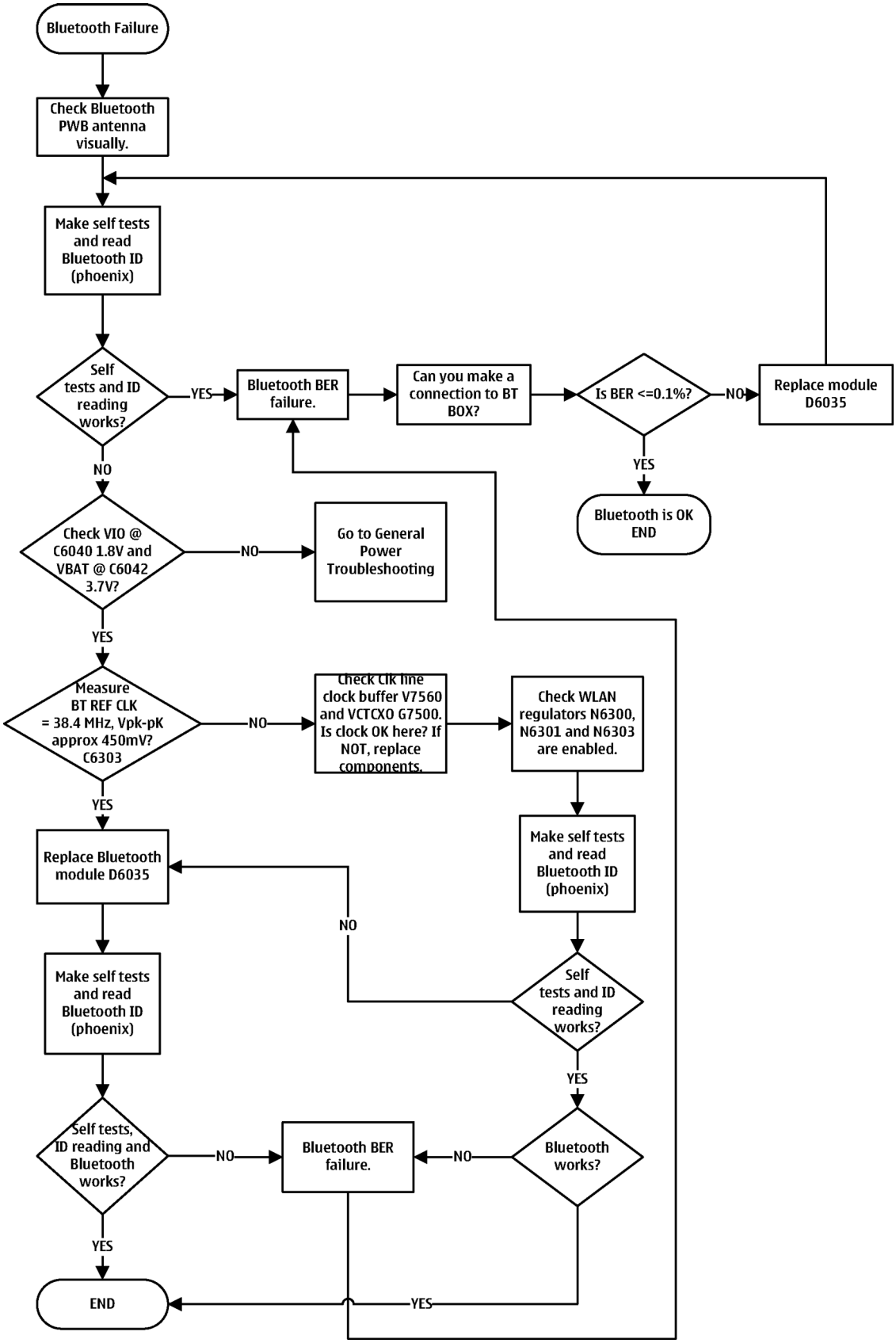
## Bluetooth troubleshooting

### Troubleshooting flow





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# Audio troubleshooting

## Audio troubleshooting test instructions

Differential external earpiece and internal earpiece outputs can be measured either with a single-ended or a differential probe.

When measuring with a single-ended probe each output is measured against the ground.

Internal handsfree output is measured using a current probe, if a special low-pass filter designed for measuring a digital amplifier is not available. Note also that when using a current probe, the input signal frequency must be set to 2kHz.

The input signal for each loop test can be either single-ended or differential.

### Required equipment

The following equipment is needed for the tests:

- Oscilloscope
- Function generator (sine waveform)
- Current probe (Internal handsfree DPMA output measurement)
- Phoenix service software
- Battery voltage 3.7V

### Test procedure

Audio can be tested using the Phoenix audio routings option. Three different audio loop paths can be activated:

- External microphone to Internal earpiece
- External microphone to Internal handsfree speaker
- Internal microphone to External earpiece

Each audio loop sets routing from the specified input to the specified output enabling a quick in-out test. Loop path gains are fixed and they cannot be changed using Phoenix. Correct pins and signals for each test are presented in the following table.

### Phoenix audio loop tests and test results

The results presented in the table apply when no accessory is connected and battery voltage is set to 3.7V.

Earpiece, internal microphone and speaker are in place during measurement. Applying a headset accessory during measurement causes a significant drop in measured quantities.

The gain values presented in the table apply for a differential output vs. single-ended/differential input.

| Loop Test | Input terminal | Output terminal | Path Gain [dB fixed] | Input voltage [mVp-p] | Differential Output voltage [mVp-p] | Output DC level [V] | Output current [mA] |
|---|---|---|---|---|---|---|---|
| External Mic to External Earpiece | XMICP and GND | HSEAR P | -3.5 | 1000 | 670 | 1.2 | |
| | | HSEAR N | | | | | |
| | | HSEAR RP | | | | | |
| | | HSEAR RN | | | | | |


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| Loop Test | Input terminal | Output terminal | Path Gain [dB fixed] | Input voltage [mVp-p] | Differential Output voltage [mVp-p] | Output DC level [V] | Output current [mA] |
|---|---|---|---|---|---|---|---|
| External Mic to Internal Earpiece | XMICP and GND | EarP and GND<br>EarN and GND | -4 | 1000 | 630 | 1.2 | |
| External Mic to Internal handsfree | XMICP and GND | HFSP P<br>HFSP N<br>HFSP RP<br>HFSP RN | 18.5 | 500 | 4300 | 0 | ~200mA (calculated) |
| Internal Mic to External Earpiece | MICP and GND | HSEAR P<br>HSEAR N<br>HSEAR RP<br>HSEAR RN | 22.5 | 100 | 1330 | 1.2 | |

## Measurement data

Earpiece signal:

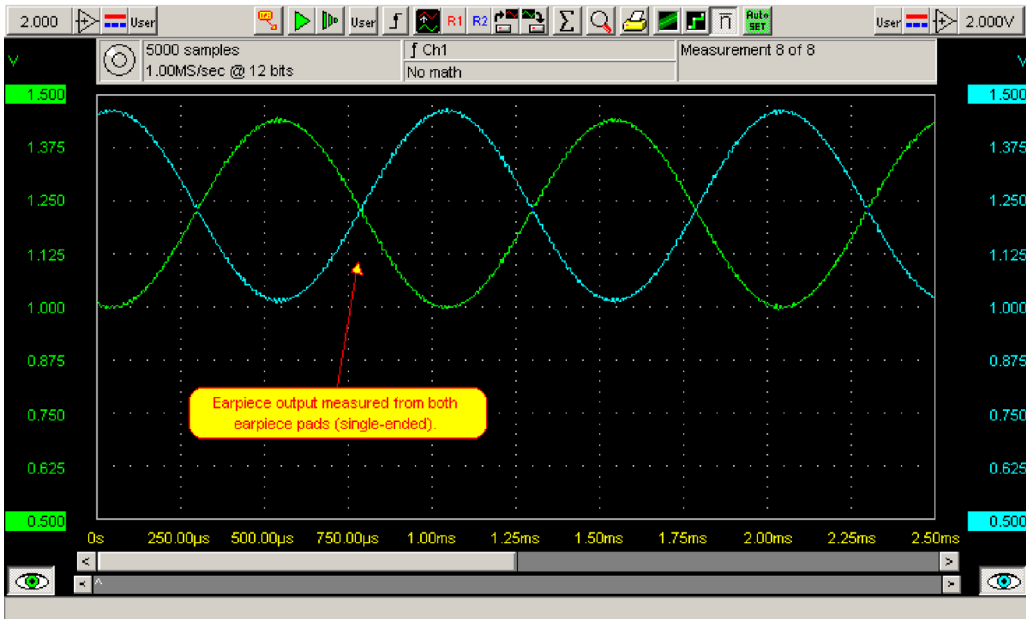


**Figure 54 Single-ended output waveforms of the Ext_in_HP_out measurement when earpiece is connected.**

Integrated hands free signal:


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**Figure 55 Single-ended output waveforms of the Ext_in_IHF_out out loop measurement when speaker is connected (measured at speaker pads). No filter is used.**

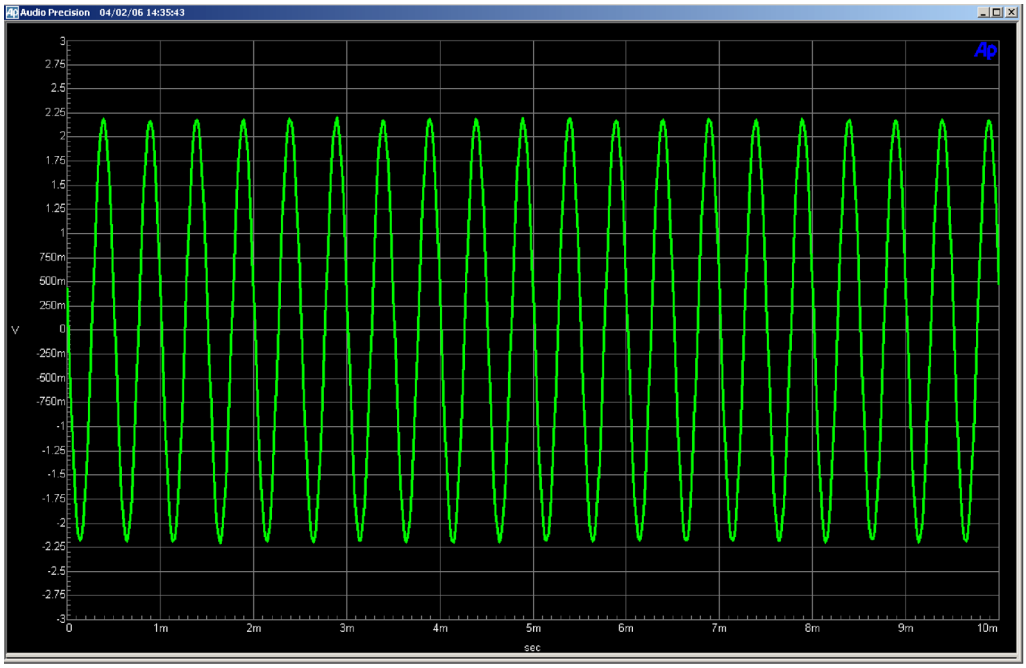


**Figure 56 Differential output waveform of the Ext_in_IHF_out out loop measurement when speaker is connected (measured at speaker pads). D-class filter is used. Input signal frequency 2kHz.**

External output from PopPort:


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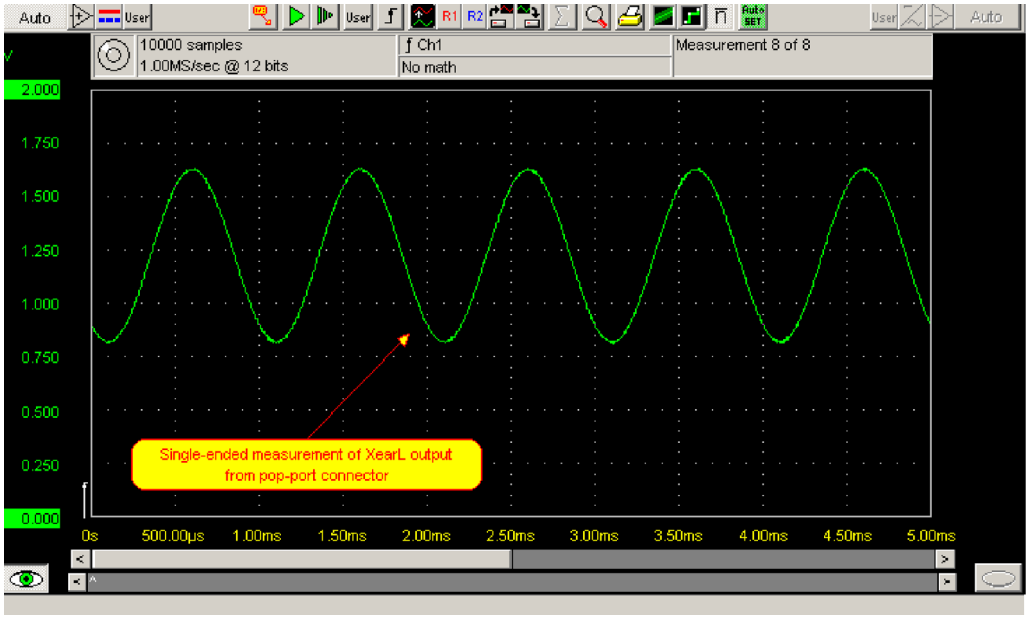


**Figure 57 Single-ended output waveform of the HP_in_Ext_out loop.**


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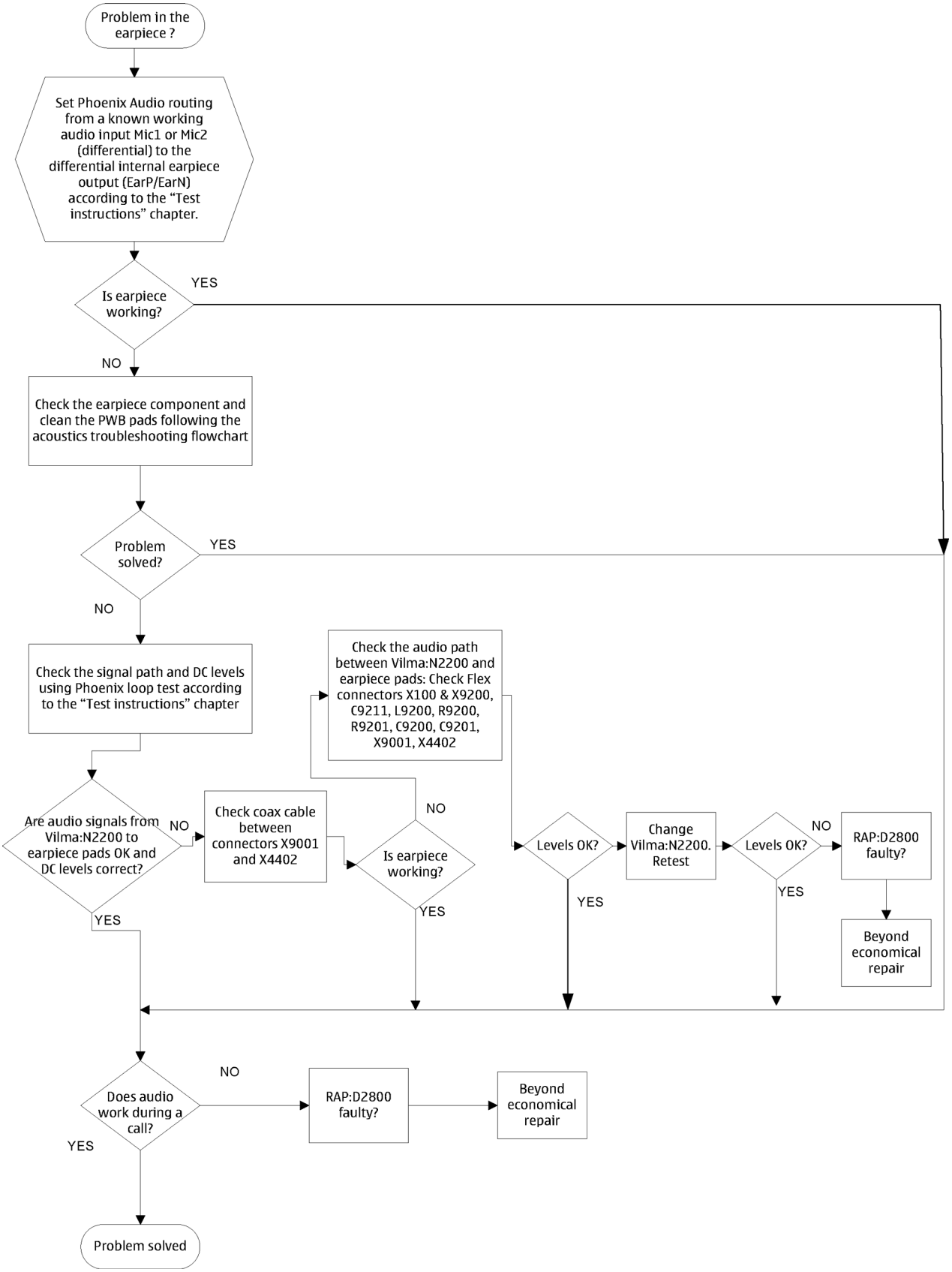
## Internal earpiece troubleshooting

### Troubleshooting flow





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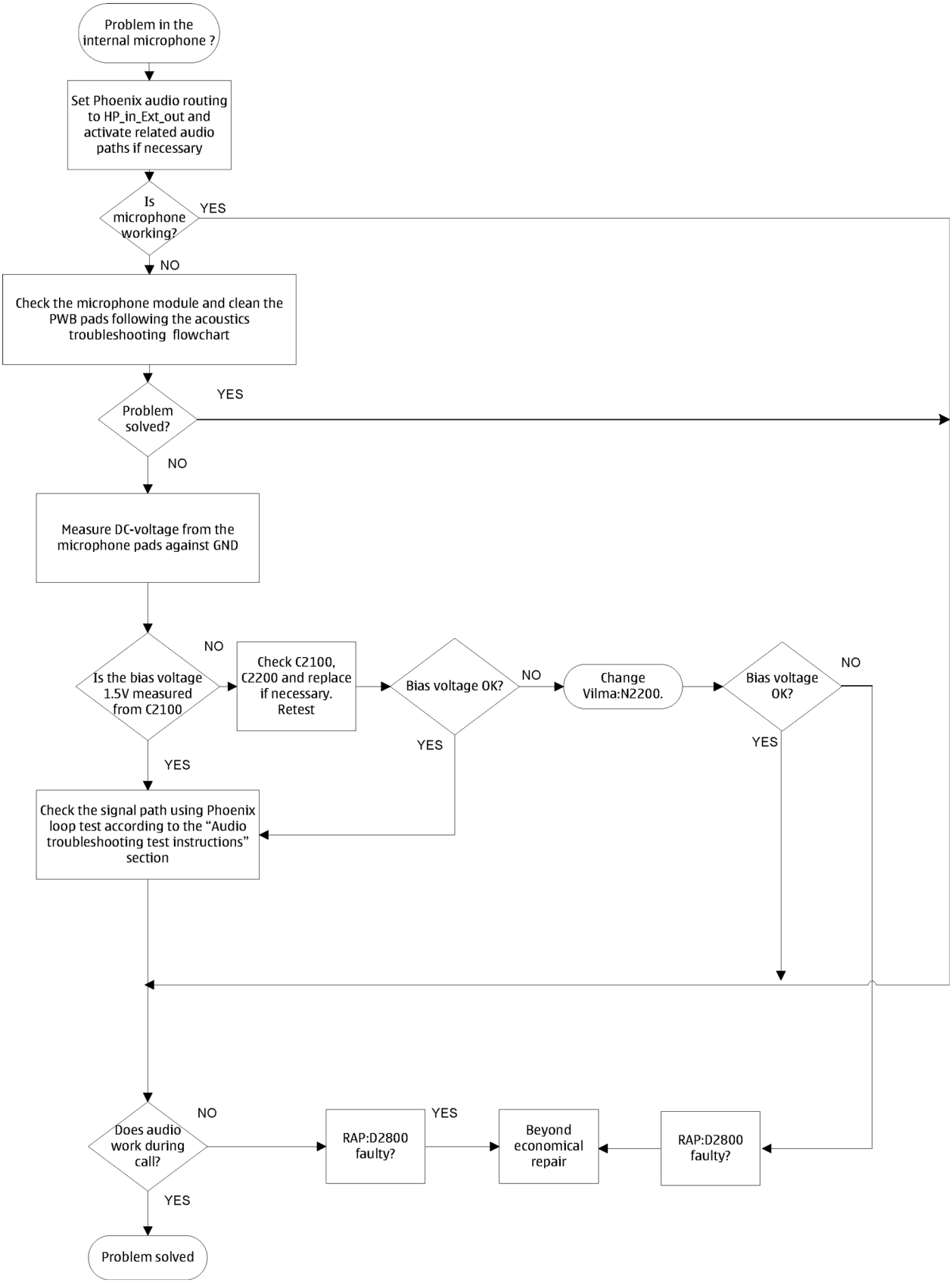
## Internal microphone troubleshooting

### Troubleshooting flow





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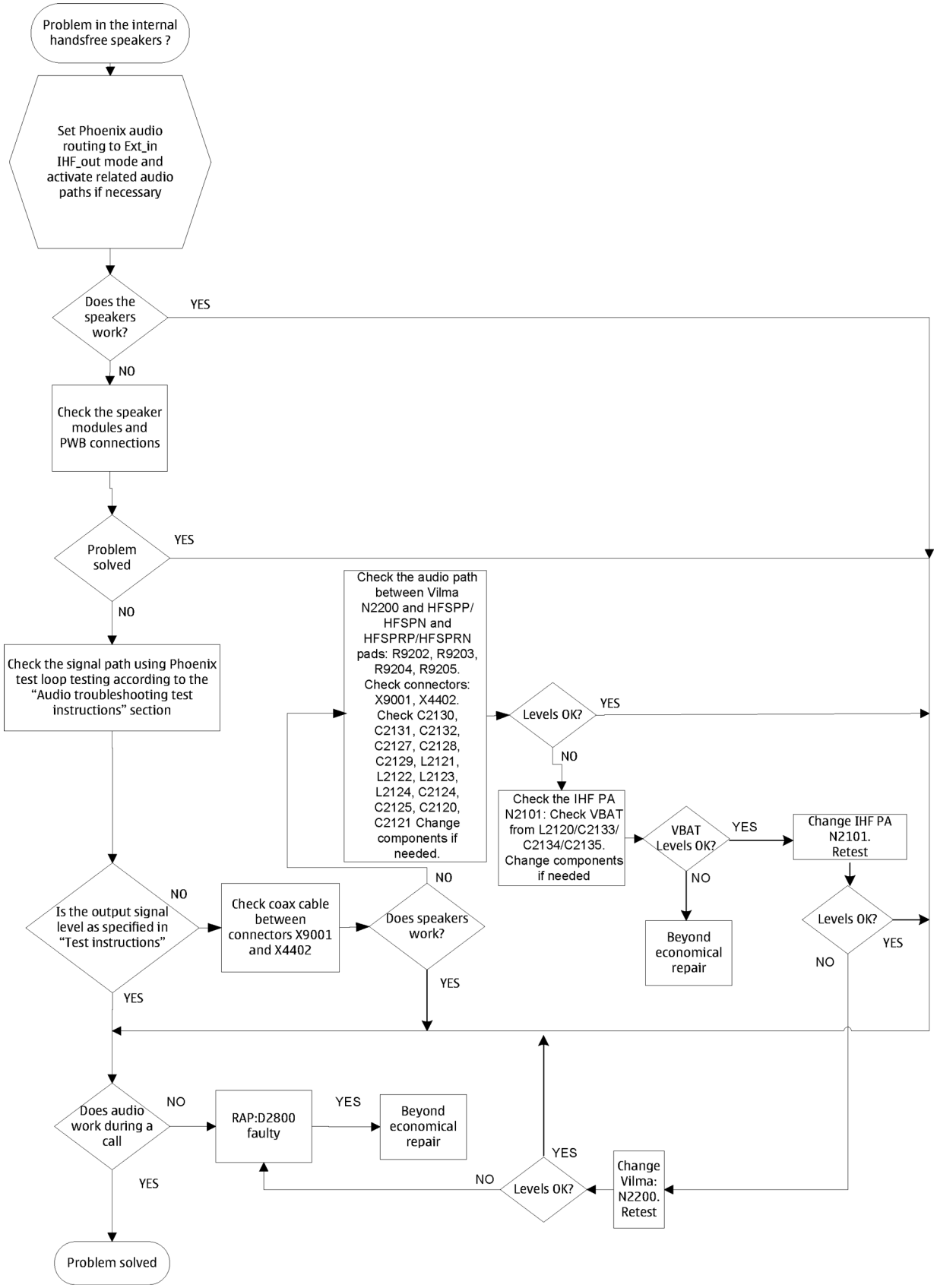
## IHF troubleshooting

# Troubleshooting flow





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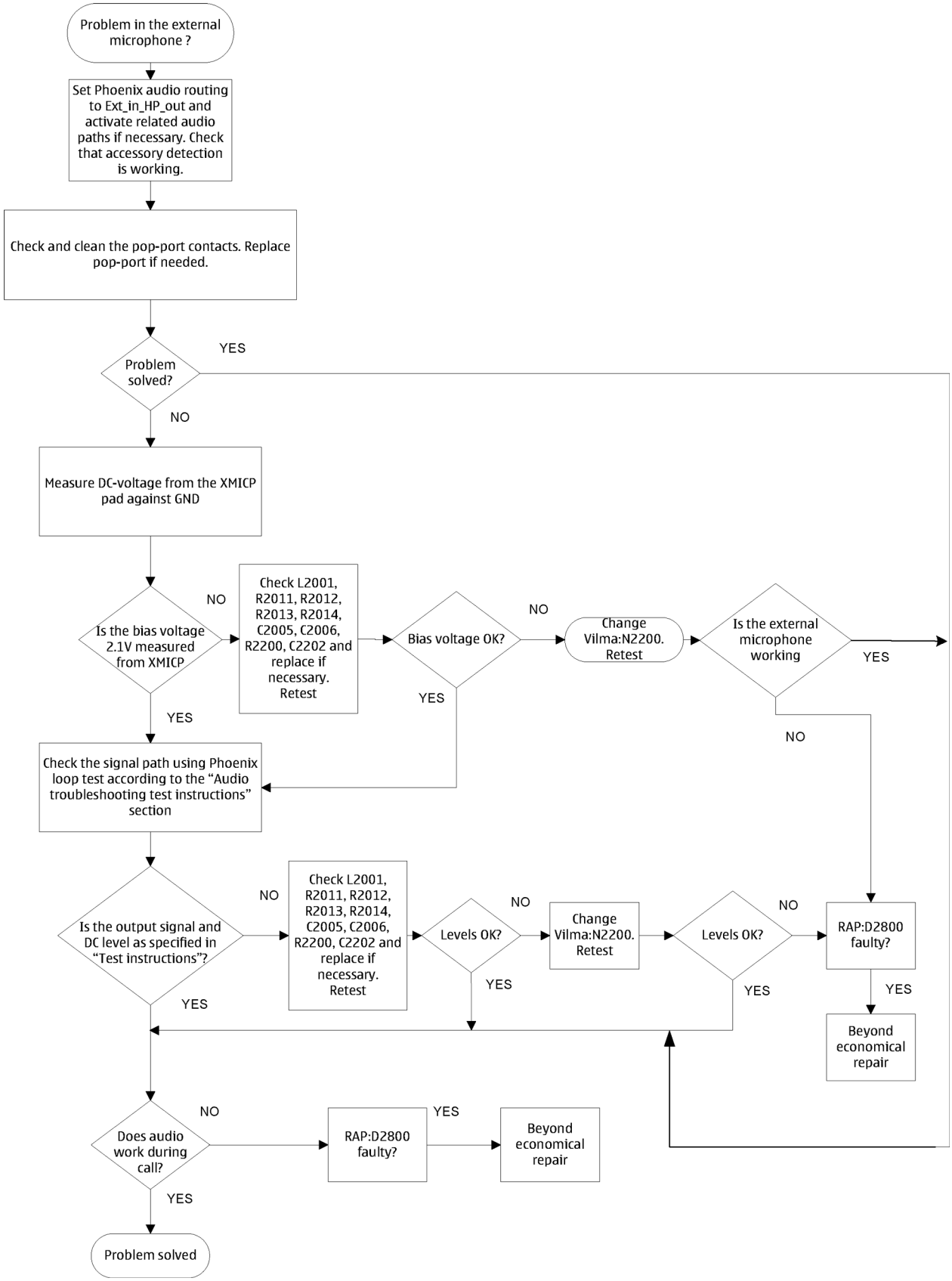
## External microphone troubleshooting

### Troubleshooting flow





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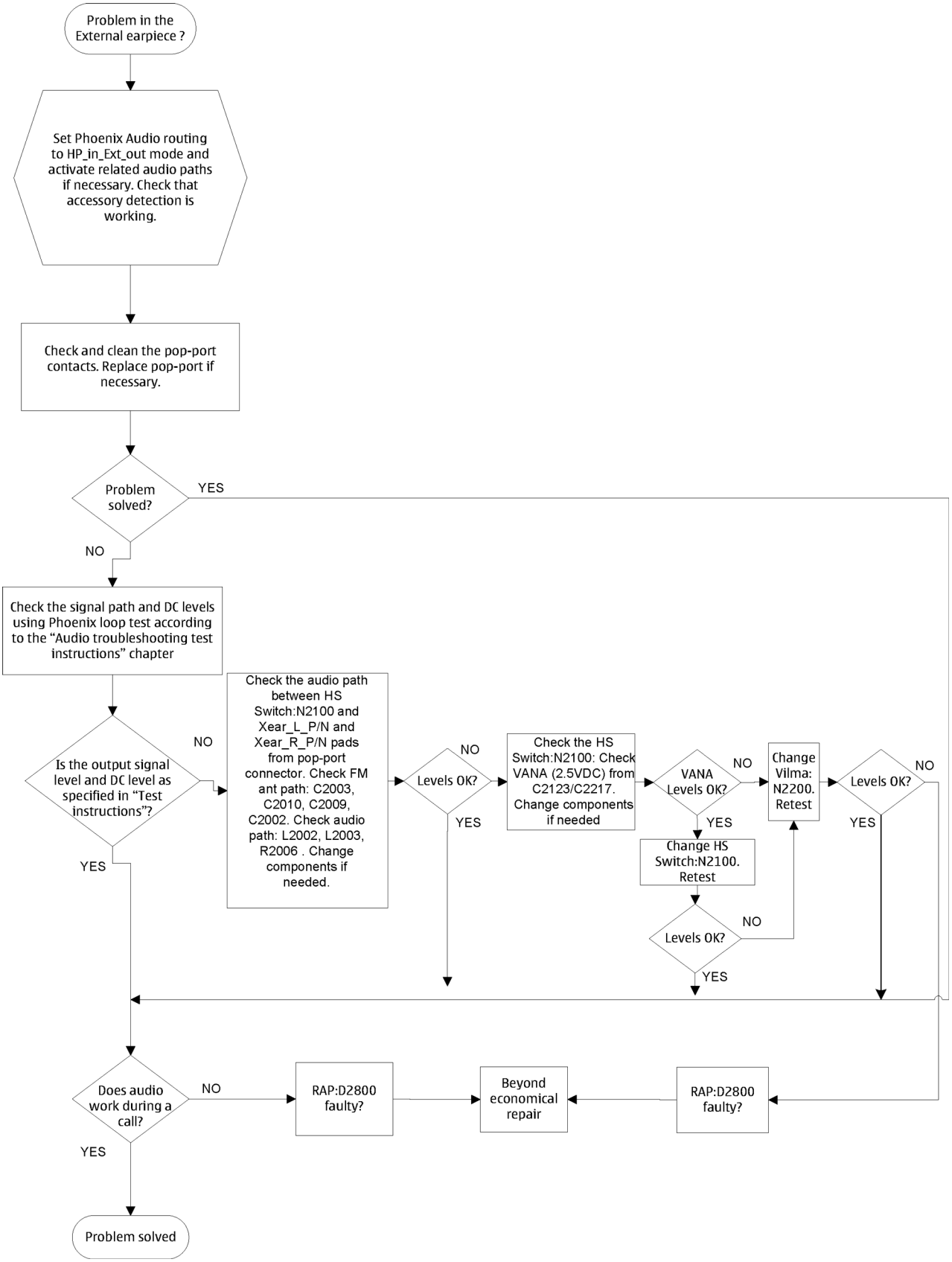
## External earpiece troubleshooting

# Troubleshooting flow





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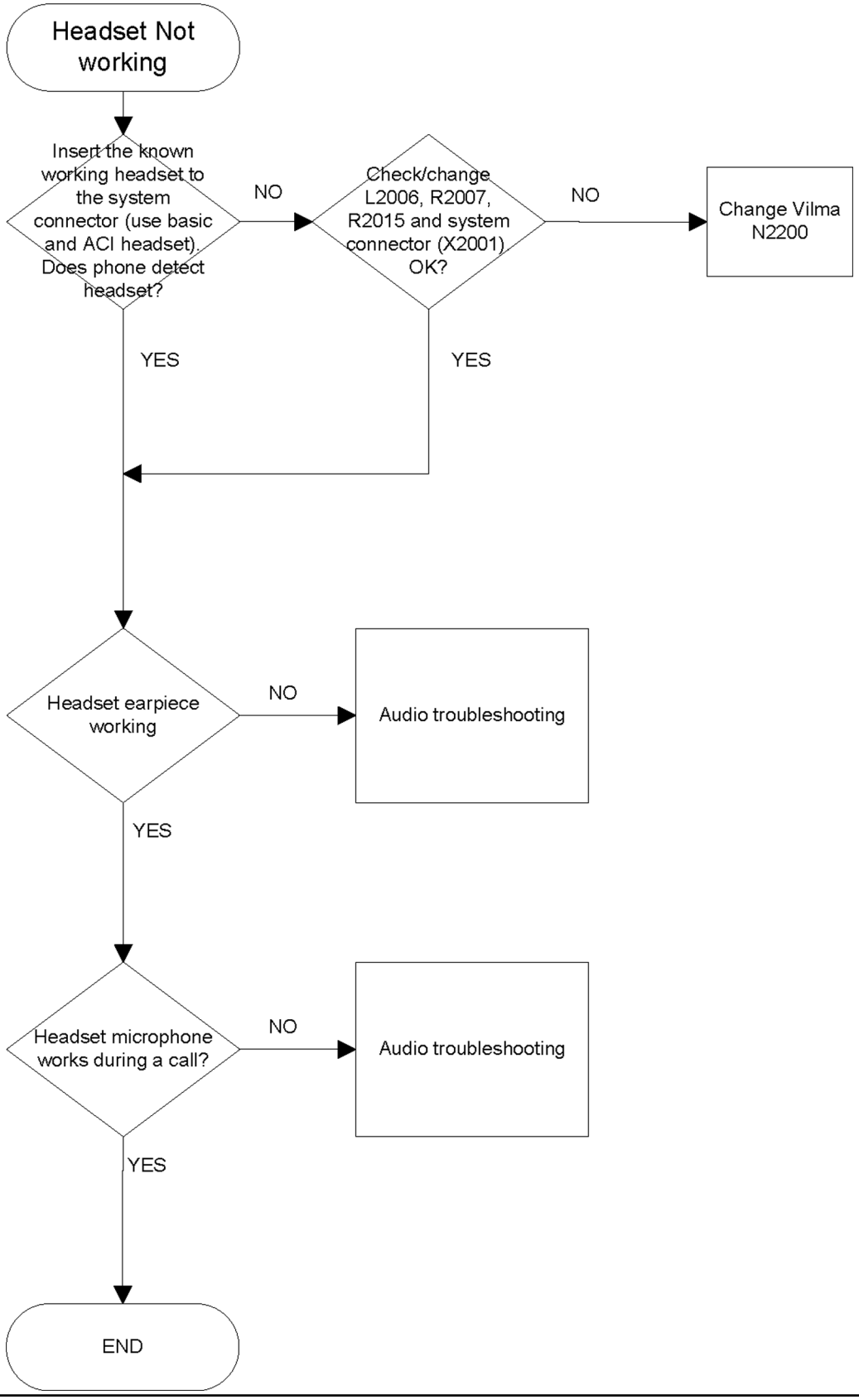
## Accessory detection troubleshooting

### Troubleshooting flow





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# Baseband manual tuning guide

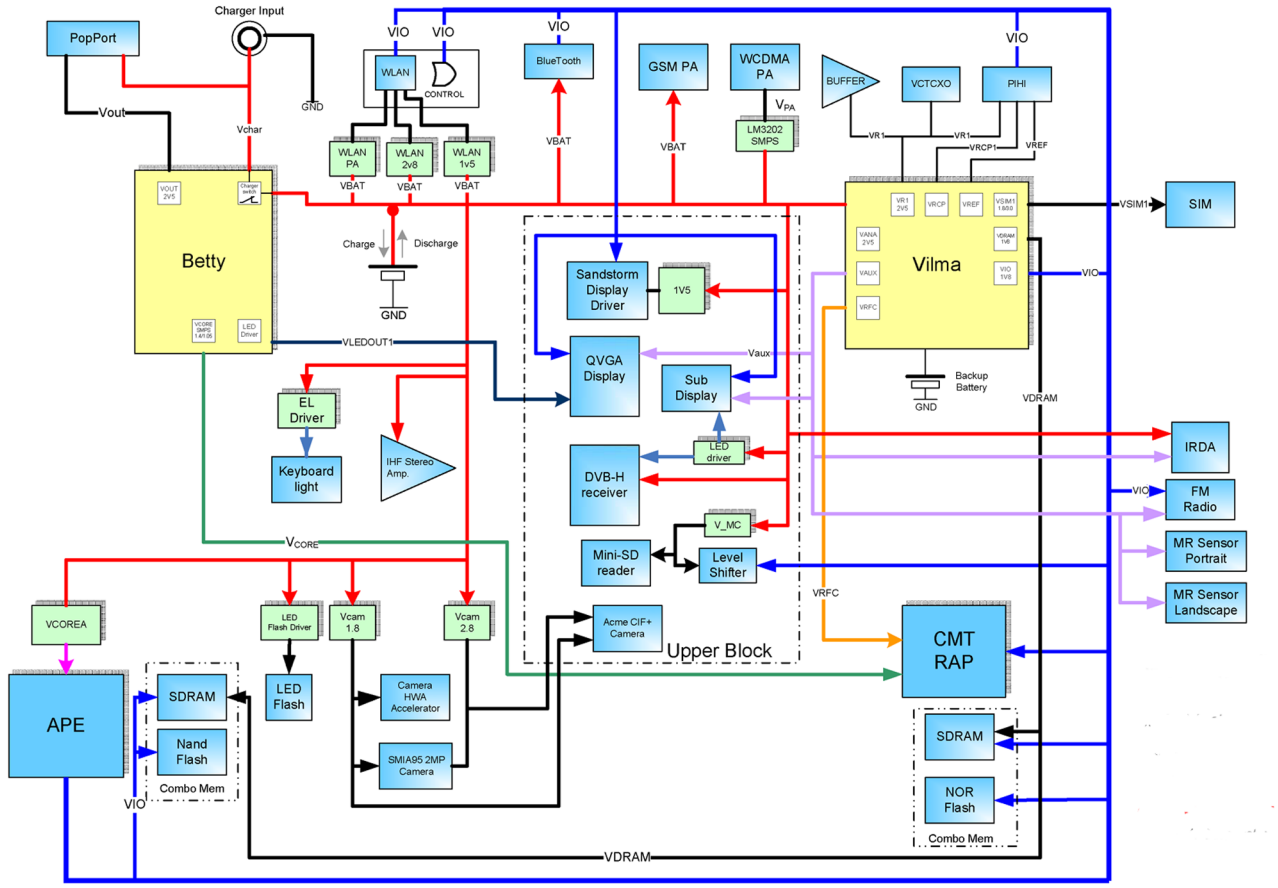
## Energy management calibration

### Prerequisites

Energy Management (EM) calibration is performed to calibrate the setting (gain and offset) of AD converters in several channels (that is, **battery voltage**, **BSI**, **battery current**) to get an accurate AD conversion result.

Hardware setup:

- An external power supply is needed.
- Supply 12V DC from an external power supply to CU-4 to power up the phone.
- The phone must be connected to a CU-4 control unit with a product-specific flash adapter.




### Steps

1. Place the phone to the docking station adapter (CU-4 is connected to the adapter).
2. Start *Phoenix* service software.
3. Choose **File→ Scan Product.**
4. Choose **Tuning→Energy Management Calibration.**
5. To show the current values in the phone memory, click **Read**, and check that communication between the phone and CU-4 works.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6. Check that the **CU-4 used** check box is checked.
7. Select the item(s) to be calibrated.

   **Note:** ADC calibration has to be performed before other item(s). However, if all calibrations are selected at the same time, there is no need to perform the ADC calibration first.
8. Click **Calibrate**.

   The calibration of the selected item(s) is carried out automatically.

   The candidates for the new calibration values are shown in the *Calculated values* column. If the new calibration values seem to be acceptable (please refer to the following "Calibration value limits" table), click **Write** to store the new calibration values to the phone permanent memory.

**Table 12 Calibration value limits**

| Parameter | Min. | Max. |
|---|---|---|
| ADC Offset | -20 | 20 |
| ADC Gain | 12000 | 14000 |
| BSI Gain | 1100 | 1300 |
| VBAT Offset | 2400 | 2650 |
| VBAT Gain | 19000 | 23000 |
| VCHAR Gain | N/A | N/A |
| IBAT (ICal) Gain | 7750 | 12250 |

9. Click **Read**, and confirm that the new calibration values are stored in the phone memory correctly. If the values are not stored to the phone memory, click **Write** and/or repeat the procedure again.
10. To end the procedure, close the *Energy Management Calibration* window.


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# 7 — RF Troubleshooting and Manual Tuning Guide


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## Introduction to RF troubleshooting

All measurements should be done using:

- spectrum analyser with a low-impedance wideband passive probe (LO-/reference frequencies and RF power levels).

  **Note:** When measuring frequencies of 4GHz, absolute level measurements are not possible with this probe. Compare levels with a known good board.

- oscilloscope with a 10:1 probe (DC-voltages and low frequency signals)

  **Caution:** A mobile phone WCDMA transmitter should never be tested with full Tx power, if there is no possibility to perform the measurements in a good performance RF-shielded room. Even low power WCDMA transmitters may disturb nearby WCDMA networks and cause problems to 3G cellular phone communication in wide area. WCDMA Tx measurements should be performed at least in an RF-shielded box and never with higher Tx power level than 0 dBm! Test full WCDMA Tx power only in RF-shielded environment.

  Also all measurements with an RF coupler should be performed in RF shielded environment because nearby base stations can disturb sensitive receiver measurements. If there is no possibility to use RF shielded environment, it should be checked that there are no transmissions on the same frequencies as used in the tests.

The RF section of the phone is built around an RF ASIC, N7500 which consists of the AHNE RF ASIC and several filters RM-100 has a GSM quad band dual PA and antenna switch module, TXFEM, N7520, and a WCDMA PA, N7540.

The WCDMA PA needs a variable supply to work efficiently. This is provided by a switch mode power supply component, N7541.

Please note that the grounding of the PA module is directly below the PA module. Therefore, it is difficult to check or change the module.

Most RF semiconductors are static discharge sensitive. ESD procedures must be followed during repair, ground straps and ESD soldering irons. RF ASICs, TXFEM, PA and SMPS are moisture sensitive, so parts must be pre-baked prior to soldering.

In addition to key components, there are lot of discrete components (resistors, inductors and capacitors) which troubleshooting is done mainly by checking if the soldering of the component is done properly.

A Capacitor can be checked for shorts and resistors for value by means of an ohmmeter, but be aware, in-circuit measurements should be evaluated carefully.

Keep in mind that all measured voltages or RF levels in the service manual are rough figures. Especially RF levels vary because of different measuring equipment or different grounding of the probe used. All spectrum analyser measurements in this manual are made with a Fluke PM9639/011 10:1 (500 ohm) probe. It is recommended that a similar kind of probe is used for all troubleshooting measurements.

When using an RF probe, use a pair of metallic tweezers to connect the probe ground to the PWB ground as close to the measurement point as possible. If measurements are performed in a product specific module jig, then “GND” pads should be used for the probe ground.

For additional RF troubleshooting instructions, see Appendix A. These instructions include descriptions/ instructions for RF self-tests as well as troubleshooting instructions for various fault cases.


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## RF key component placement

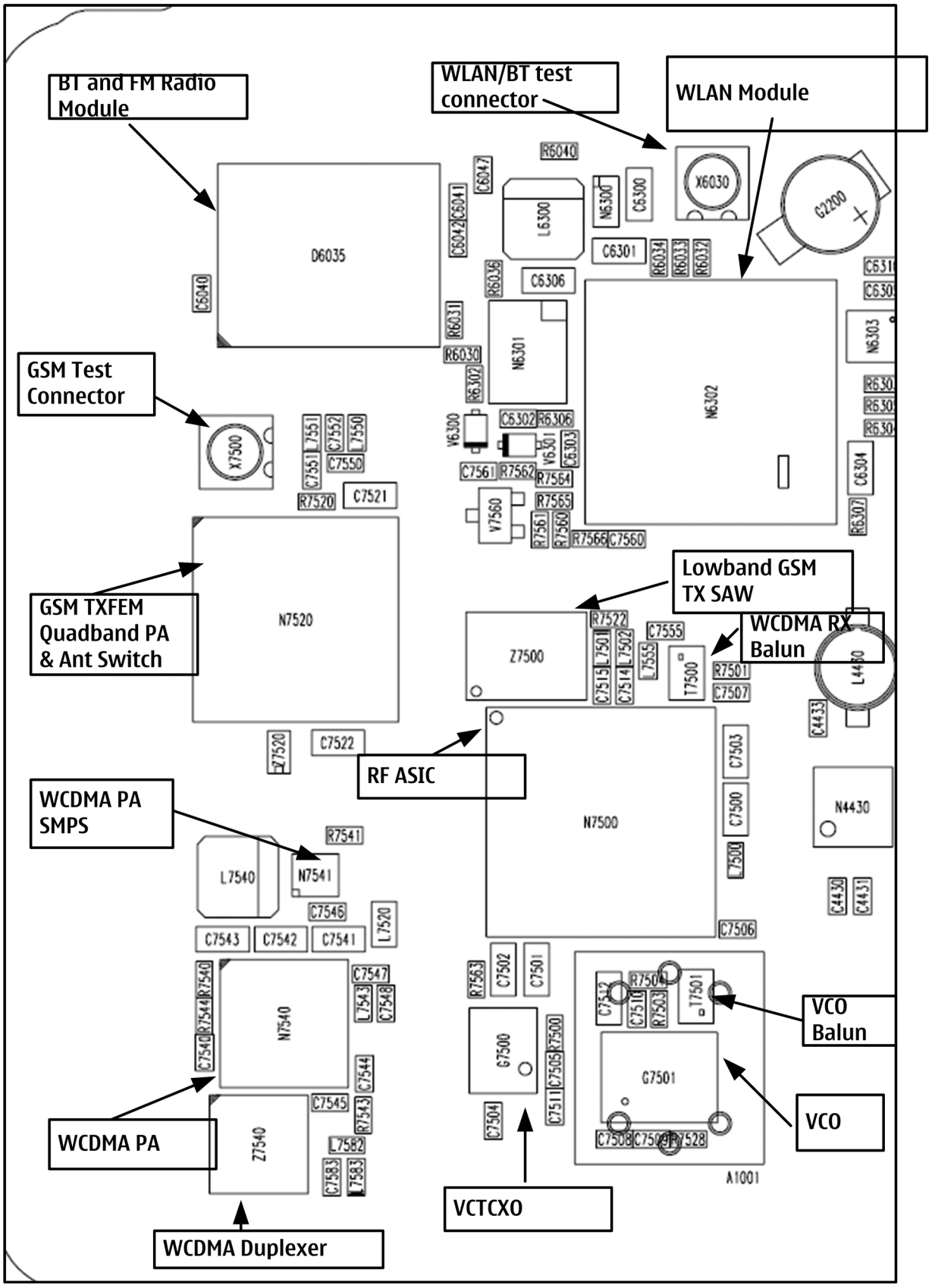


**Figure 58 RM-100 RF key component placement**


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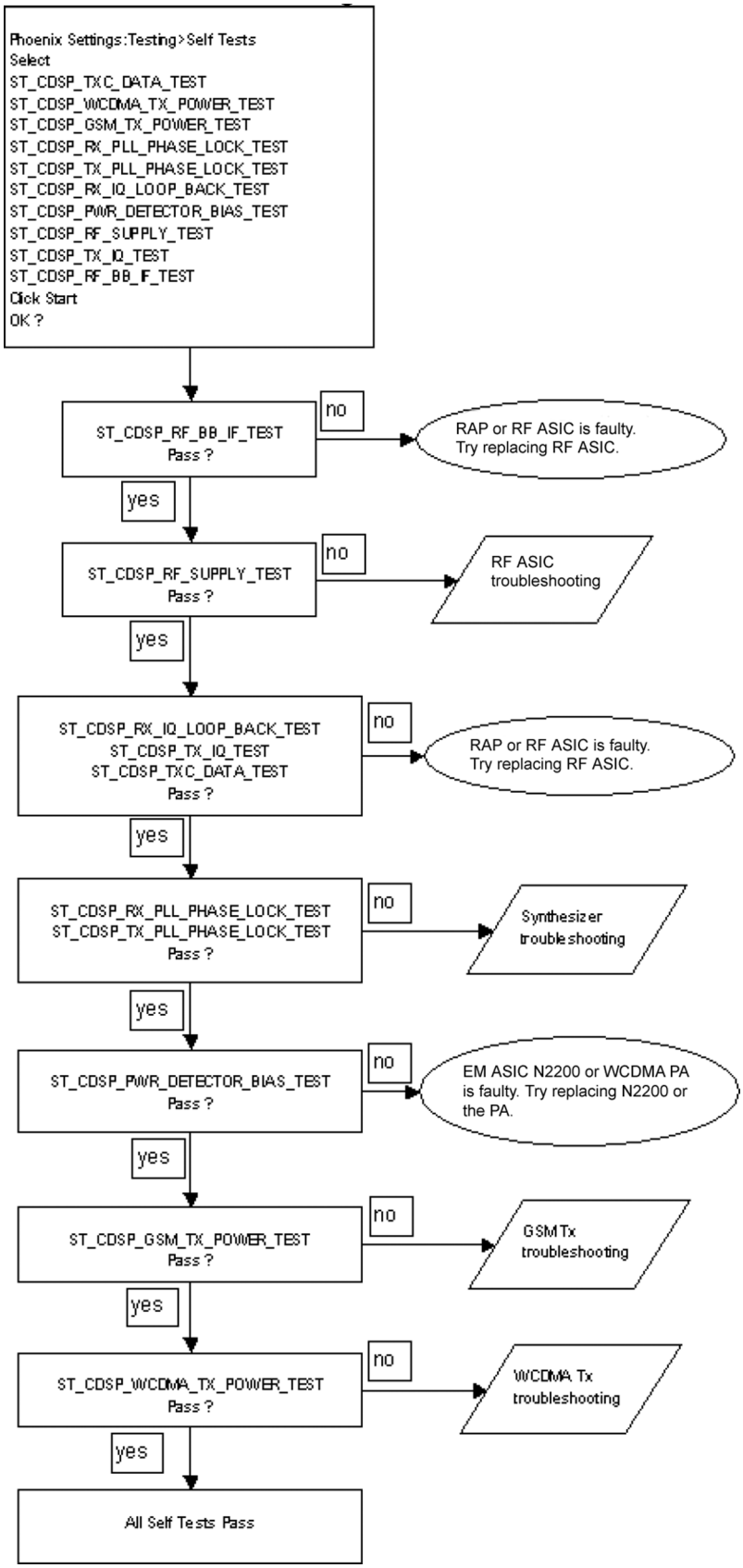
## Self test troubleshooting

### Troubleshooting flow





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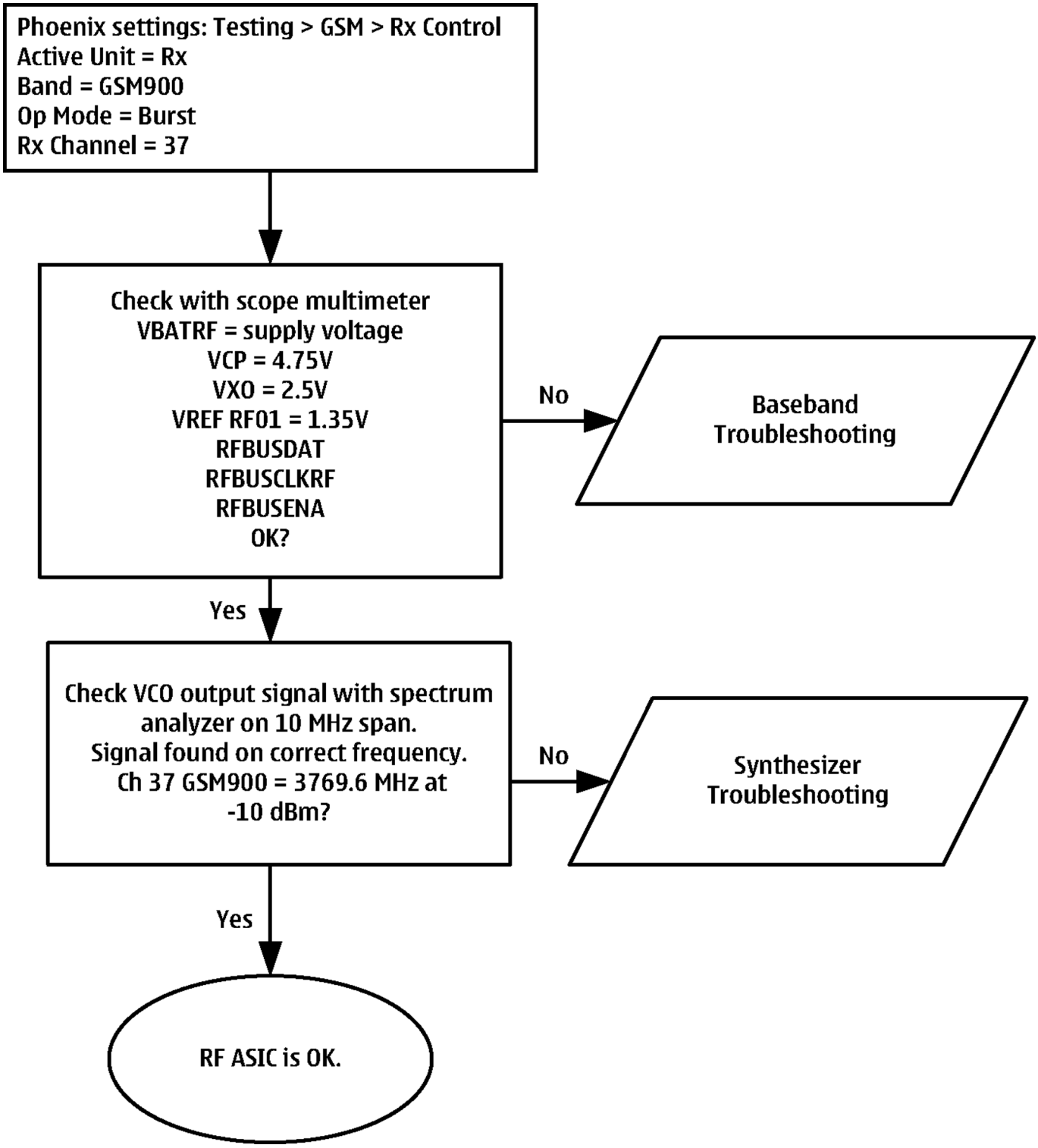
## RF ASIC troubleshooting

### Troubleshooting flow





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## RF ASIC test points

| Signal name | RF ASIC N7500 | Expected Result V |
|---|---|---|
| VBATRF | C7500 | 3.6 |
| VCP (VCP1 & VCP2) | C2222 | 4.75 |
| VXO | C7504 | 2.5 |
| VREF01 | R7501 | 1.35 |

| Signal name | RF ASIC N7500 |
|---|---|
| RFBUSDAT | J7519 |
| RFBUSCLKRF | J7520 |
| RFBUSENA | J7521 |
| TXRESETX | N/A |


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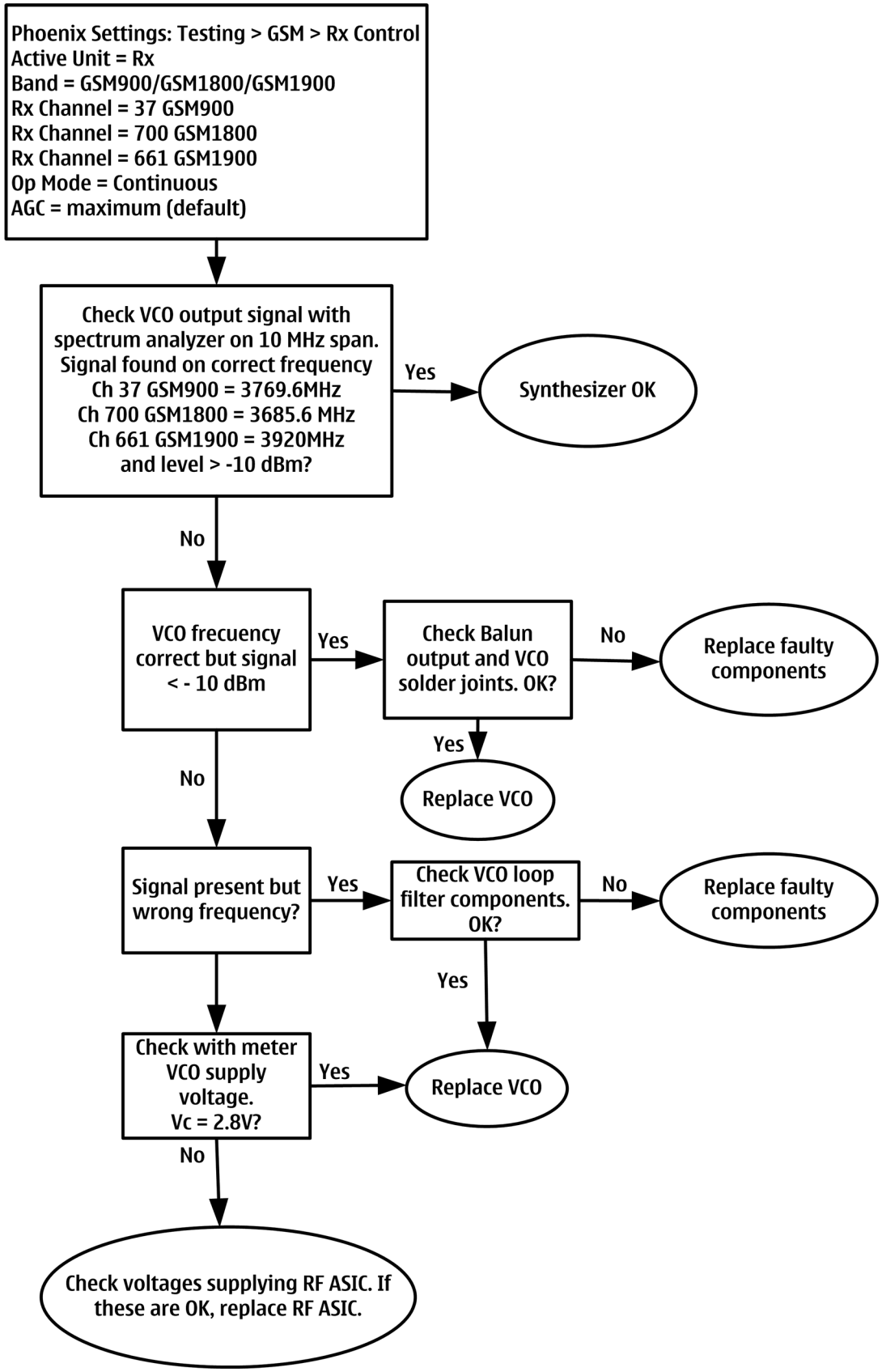
## Synthesizer troubleshooting

### Troubleshooting flow





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### Synthesizer test points

| Measure | RF ASIC N7500 | Expected Result |
|---|---|---|
| VCTXCO output voltage | G7500 pin 3 | 38.4MHz 800 mVpp |
| RFCLKEXT | C7506 | 38.4MHz 500 mVpp |
| VCTXCO AFC voltage | C7505 | 1V |

| Measure | RF ASIC N7500 | Expected Result |
|---|---|---|
| VCO | G7501 | 3526,4 MHz |

| Measure | RF ASIC N7500 | Expected Result |
|---|---|---|
| VCO supply voltage | C7509 | 2.8V |

| Measure | RF ASIC N7500 | Expected Result |
|---|---|---|
| VCO control voltage | C7510 | 1 to 3 V |

| RF ASIC N7500 |
|---|
| C7510, C7512, R7503, R7504 |

## Receiver troubleshooting

### Introduction to Rx troubleshooting

Rx can be tested by making a phone call or in local mode. For the local mode testing, use the Phoenix service software.

The primary Rx troubleshooting parameter is RSSI (Received Signal Strength Indicator). For GSM RSSI measurement, see GSM Rx chain activation for manual measurements / GSM RSSI measurement (page 7–12), and for the same measurement in WCDMA, see WCDMA RSSI measurement (page 7–13).


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In GSM, the input signal can be either a real GSM signal or a CW (Continuous Wave) signal, which is 67.771 kHz above the carrier frequency.

In WCDMA, the input signal can be either a real WCDMA signal or a CW signal, which is 1 MHz above the carrier frequency.

For service tool usage instructions, refer to the section **Service Tools and Service Concepts**.

## Related information

- WCDMA Rx chain activation for manual measurement (page 7–13)

# GSM Rx chain activation for manual measurements / GSM RSSI measurement

## Context

RSSI signal measurement is the main Rx troubleshooting measurement. The test measures the strength of the received signal.

I and Q branches can be measured separately. In GSM, the input signal can be either a real GSM signal or a CW (Continuous Wave) signal that is 67.771 kHz above the carrier frequency.

## Steps

1. Start *Phoenix* service software.
2. Choose **Testing→GSM→RSSI Reading** .
3. Set the RF signal generator for a channel frequency +67.771 kHz in CW mode with a –80 dBm signal level.

   Alternatively set the cellular tester downlink channel to the appropriate channel. Make sure that the tester is set to continuous mode, not to burst mode.
4. In the *RSSI Reading* window, select the appropriate band and channel.

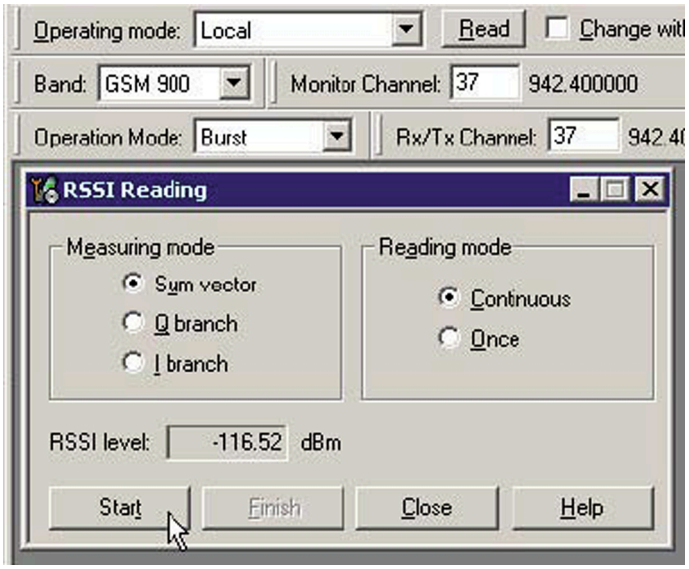


**Figure 59 *RSSI Reading* window**

5. To start the measurement, activate GSM Rx chain, click **Start**.

## Results

RSSI reading values of the selected band and channel are displayed. The RSSI level must be the same value as that which is set at the signal generator (-80 dBm).


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## WCDMA Rx chain activation for manual measurement

### Steps

1. Start *Phoenix* service software.
2. Choose **Testing→WCDMA→Rx Control** .
3. In the *Rx Control* window:

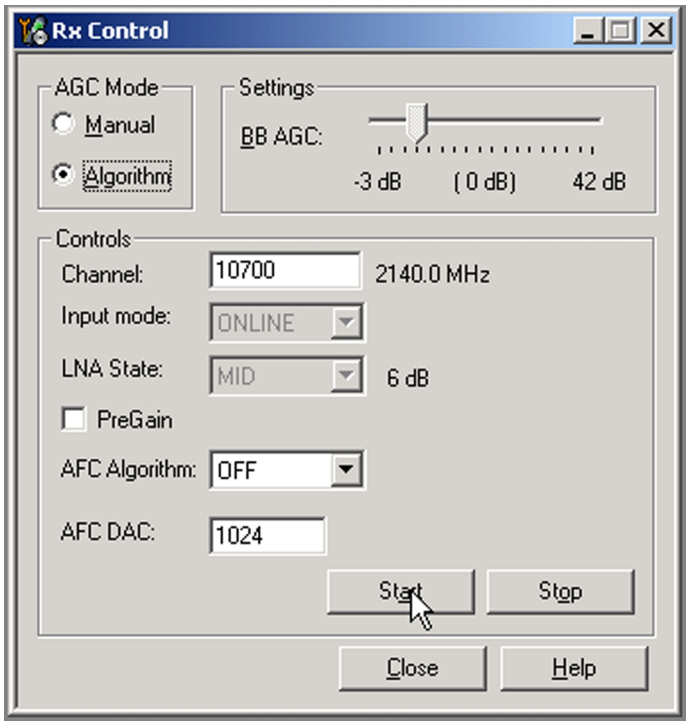


**Figure 60 *Rx Control* window**

- Set **AGC Mode** to **Algorithm**.
- Set **Channel** to **10700**.
- Set **AFC Algorithm** to **OFF** (Default = **OFF**).

### Next actions

When settings are ready, click **Start** to activate them.

If settings are changed later on (for example, you give a new channel number), you will need to click **Stop** and **Start** again.

**Note:** Clicking **Stop** also disables **Tx Control** if that was active!

## WCDMA RSSI measurement

### Prerequisites

WCDMA Rx must be activated before RSSI can be measured. See WCDMA Rx chain activation for manual measurement (page 7–13).

### Steps

1. Start *Phoenix* service software.
2. Choose **Testing→WCDMA→Rx Power Measurement** .


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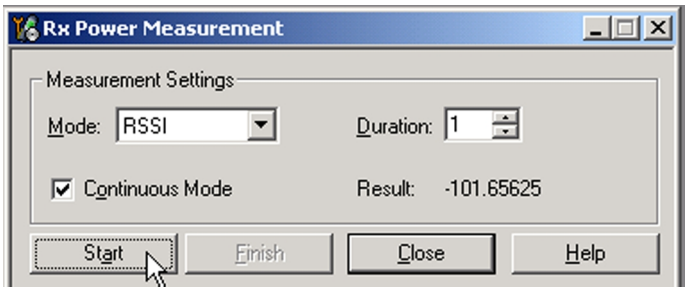
3. In the *Rx Power Measurement* window, choose the following settings:
   - Mode: RSSI
   - Continuous Mode




4. To perform the measurement, click **Start**.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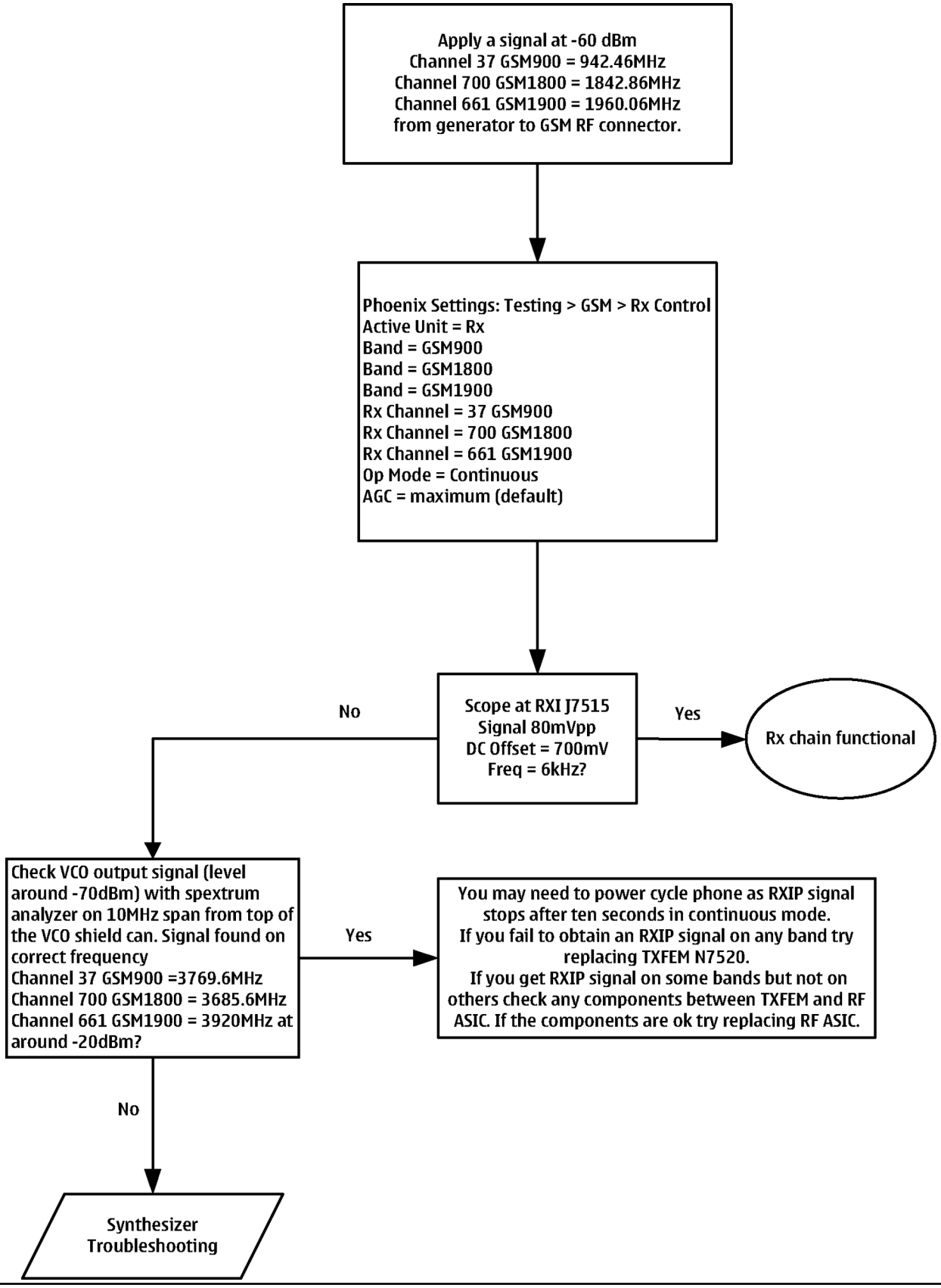
## GSM receiver troubleshooting

### Troubleshooting flow





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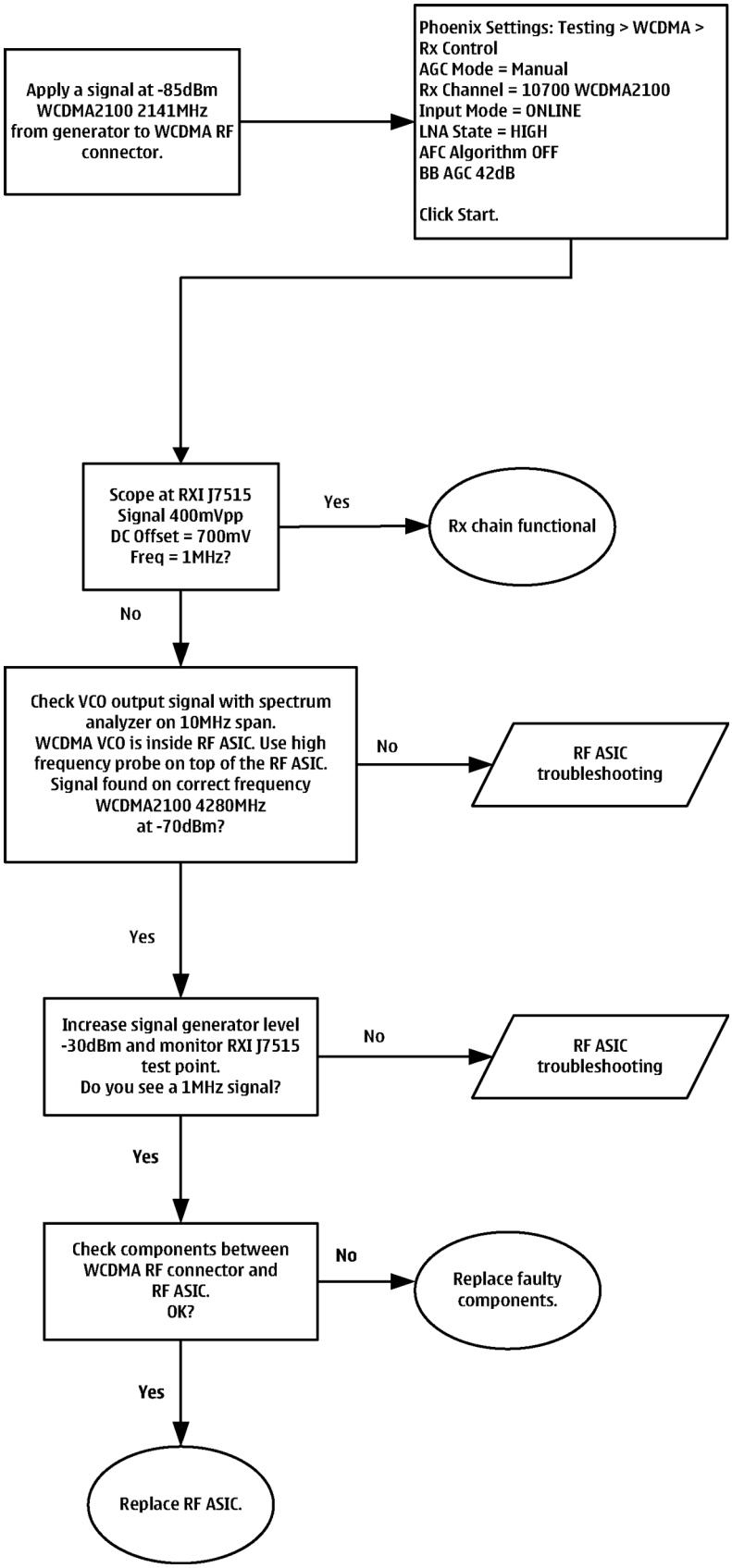
## WCDMA receiver troubleshooting

### Troubleshooting flow





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### Receiver test points

| Measure | RF ASIC N7500 | Expected Result |
|---|---|---|
| RXIP | J7515 | 400 mVpp and 700mVDC |
| RXQP | J7517 | 400 mVpp and 700mVDC |
| RXQN | No test point | 400 mVpp and 700mVDC |

| Band | RF ASIC 7500 | Expected Result |
|---|---|---|
| GSM1800 | C7515 | 1842,8677 1 MHz at -65dBm |
| GSM1900 | C7514 | 1960,0677 1 MHz at -65dBm |

## Transmitter troubleshooting

### General instructions for Tx troubleshooting

#### Context

- Tx troubleshooting requires Tx operation.
- Do not transmit on frequencies that are in use.
- Transmitter can be controlled in the local mode for diagnostic purposes.
- The best diagnostic tool for GSM transmitter testing is **RF Controls**, and for the WCDMA transmitter testing **Tx Control**.

  Tx IQ tuning and Tx power tuning can be also used in some cases.
- Remember that retuning is not a repair procedure.

The first set of steps instructs how to assemble the test setup. This setup is general for all Tx troubleshooting tasks.

Alternative steps provide specific troubleshooting instructions for *Phoenix* service software. The first section is for the EGSM900/GSM1800/GSM1900 bands and the latter for WCDMA.

> **Caution:** Never activate the GSM or WCDMA transmitter without a proper antenna load. There should be always 50 ohm load connected to the RF connector (antenna, RF-measurement equipment or at least 2 watts dummy load), otherwise GSM or WCDMA PA may be damaged.


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## Steps

1. Connect a module jig to a computer.

   Make sure that you have a PKD-1 dongle connected to the computer parallel port.

2. Connect a DC power supply to a product-specific module jig.

   **Note:** When repairing or tuning a transmitter, use an external DC supply with at least 3 A current capability.

   Set the DC supply voltage to 3.8 V.

3. Connect an RF cable between the RF connector of the product-specific module test jig and measurement equipment or alternatively use a 50 ohms (at least 2 W) dummy load in the module test jig RF connector; otherwise GSM or WCDMA PA may be damaged.

   **Note:** There are three antenna connectors in the module jig:

   - one for GSM
   - one for WCDMA
   - one for Bluetooth and WLAN* (* = if applicable)

   Make sure that all connections are made to the correct RF connector.

   Normally a spectrum analyser is used as measurement equipment.

   **Note:** The maximum input power of a spectrum analyser is +30 dBm.

   To prevent any damage, it is recommended to use 10 dB attenuator on the spectrum analyzer input.

4. Set Tx on.

   i Place the phone module to the test jig and start *Phoenix* service software.

   ii Initialize connection to the phone (with FPS-10 use FBUS when using a DAU-9S cable and a COMBOX driver).

   iii Choose **File→Open Product→xx-x*** (* = type designator of the phone) or **File→Scan Product.** .

   iv From the toolbar, set **Operating mode** to **Local.**

## Alternative steps

- EGSM900/GSM1800/GSM1900 troubleshooting

  i Choose **Testing→GSM→RF Controls.**

  ii In the *RF Controls* window:

  - Choose **Band**: **GSM900** or **GSM1800** or **GSM1900** (Default = **GSM900**).
  - Set **Rx/Tx channel** in the following way:
    - GSM900: **37**
    - GSM1800: **700**
    - GSM1900: **661**
  - Set **Active unit** to **Tx** (Default = **Rx**).
  - Set **Operation Mode** to **Burst** (Default = **Burst**).
  - Set **Edge** to **Off** (Default).
  - Set **Tx Data Type** to **All 1** (Default = **All 1**).
  - Set **Tx PA Mode** to **High** (Default).
  - Set **Tx Power Level** in the following way:
    - GSM900: **5** (Default = **19**)


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- GSM1800: **0** (Default = **15**)
- GSM1900: **0** (Default = **15**)

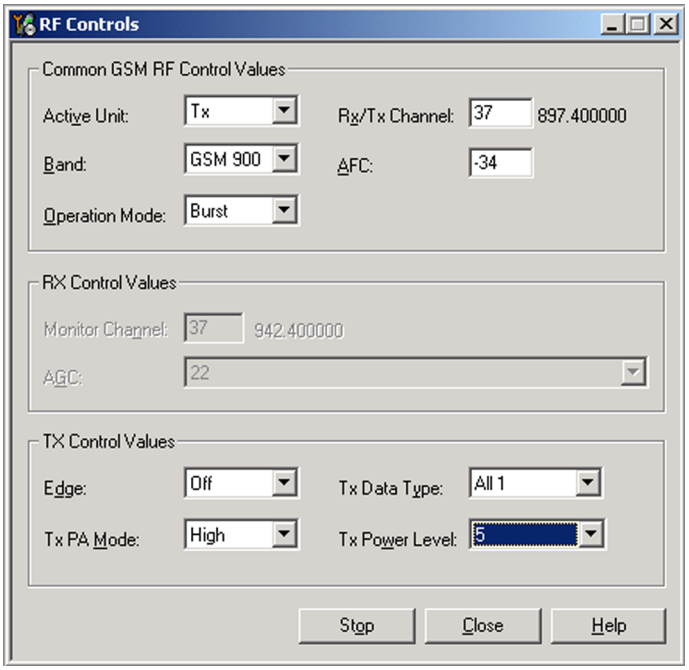


**Figure 61 *RF Controls* window**

- WCDMA troubleshooting
  i Choose **Testing→WCDMA→Tx Control.**
  ii In the *Tx Control* window:
  - Select the **Algorithm mode** tab.
  - Set **Start level** to **0** dBm (Default = **0**).
  - Set **Step size**, **Step count** and **Sequence** to **0** (Default = **0**).
  - In the **Scrambling code** pane set **Code class** to **LONG** (Default = **LONG**), and **Code** to **16** (Default = **16**).
  - For **DPDCH** set the following values:
    - **Code number**: **0**
    - **Code class**: **2**
    - **Weight**: **15**
  - For **DPCCH** set the following values:
    - **Code number**: **0**
    - **Code class**: **2**
    - **Weight**: **8**
  - Set **Channel** to **9750**.
  - Check the **DPDCH enabled** check box (Default).


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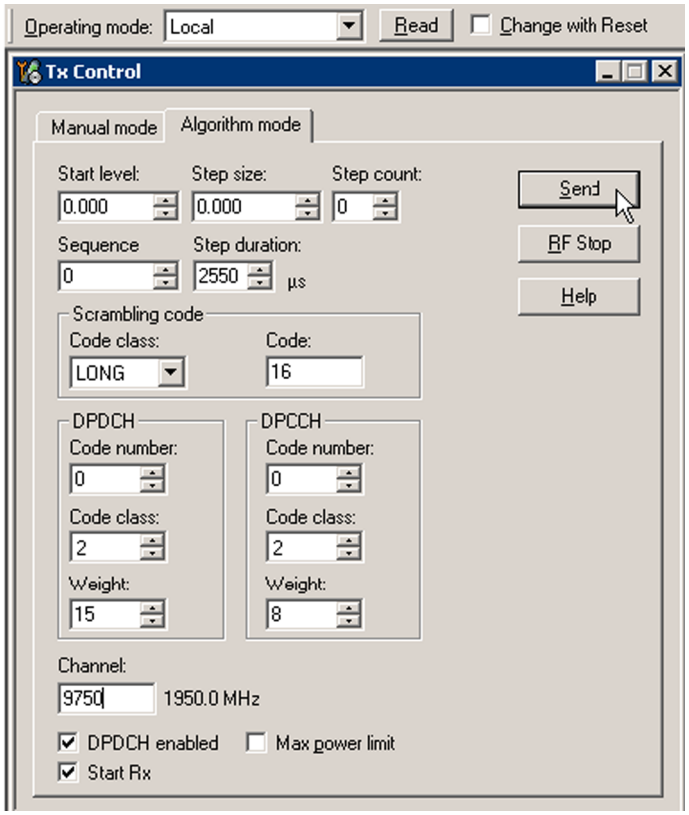


**Figure 62** ***Tx Control*** **window**

## Next actions

When settings are done, click **Send** to enable them.

If you change the settings (e.g. give a new channel number), you need to click **Stop** and **Send** again.


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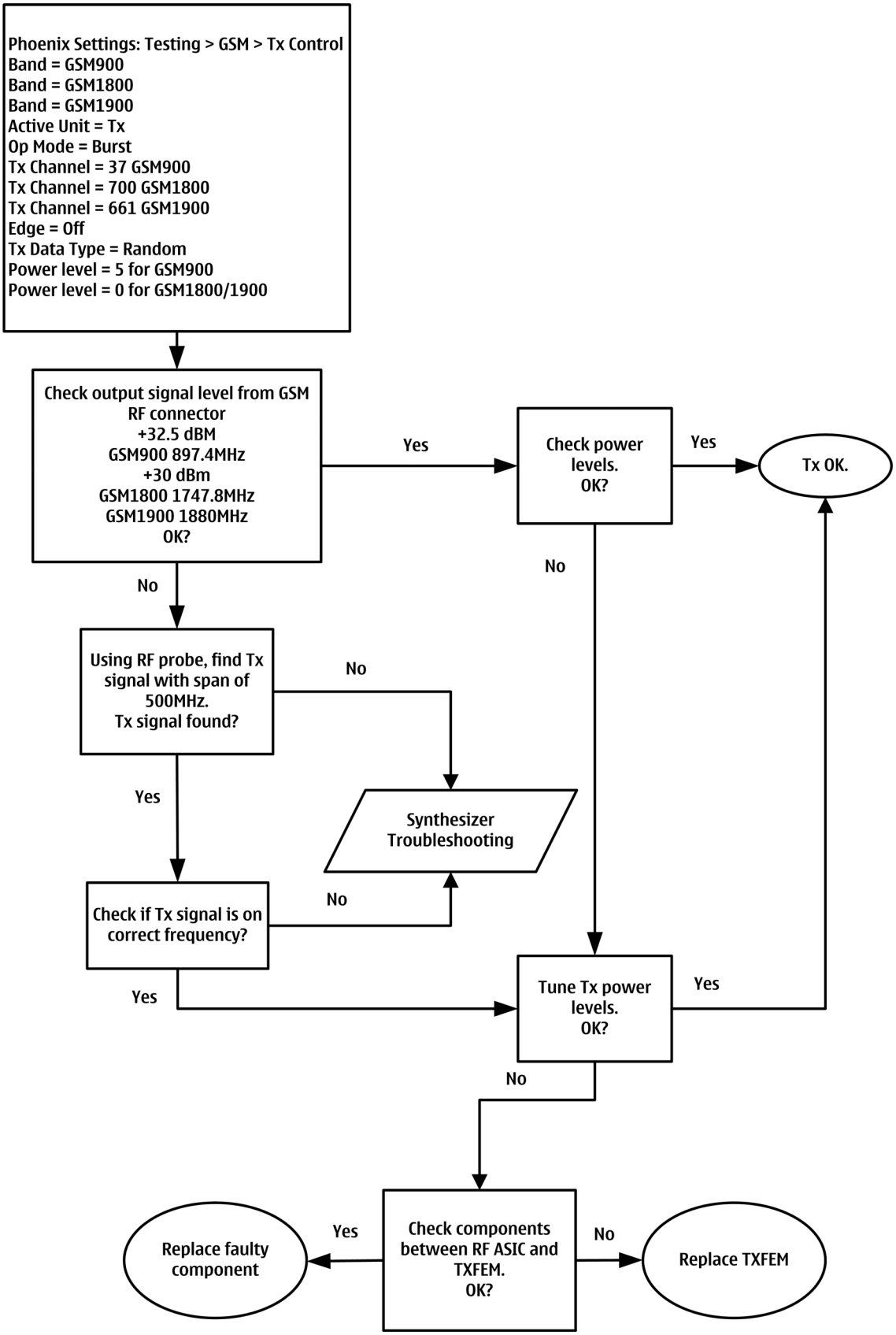
## GSM transmitter troubleshooting

### Troubleshooting flow





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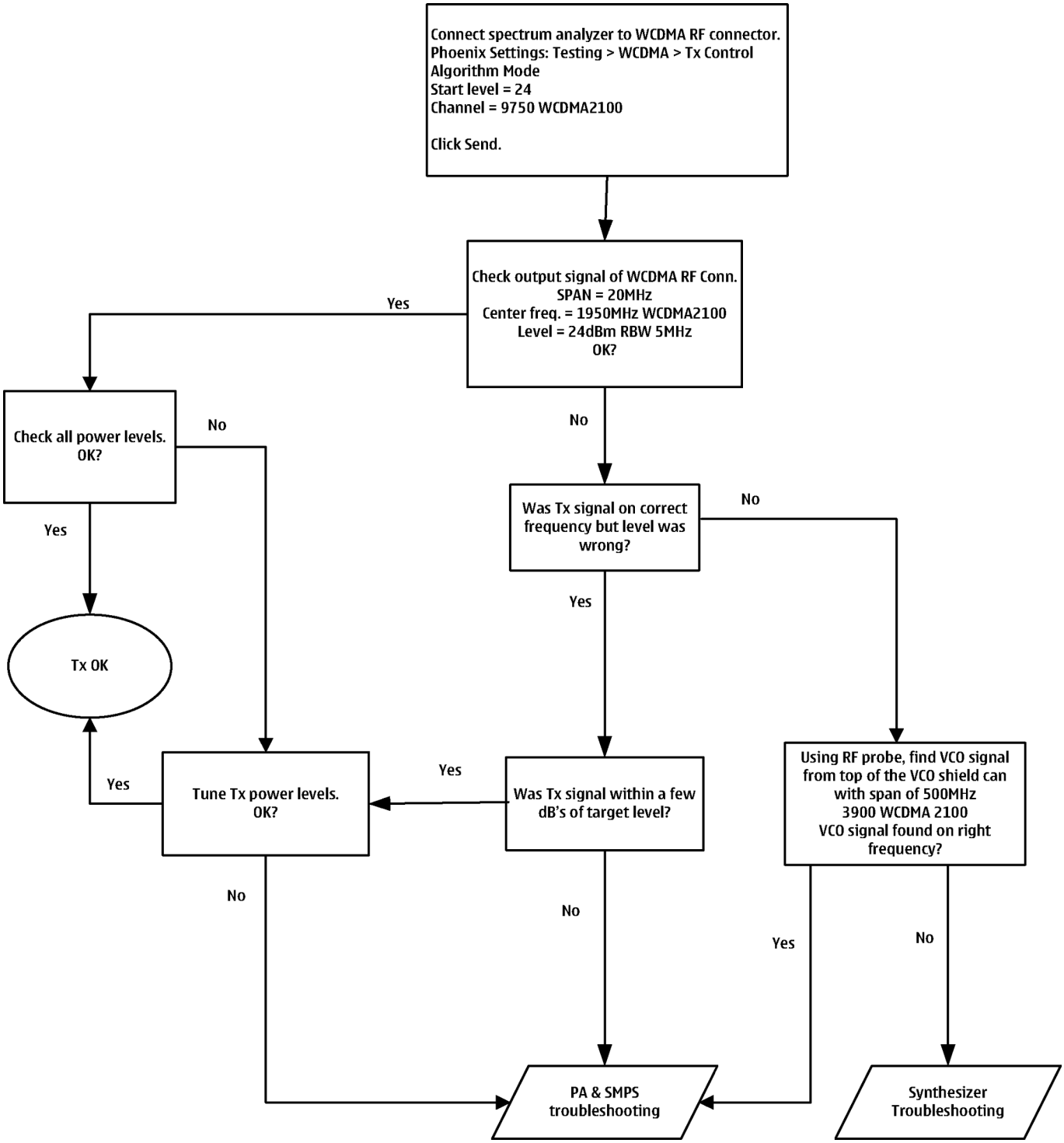
## WCDMA transmitter troubleshooting

### Troubleshooting flow





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## Transmitter test points

| Band | RF ASIC N7500 | Expected Result |
|---|---|---|
| GSM900 | R7522 | 897,4 MHz |
| GSM1800 | Z7520 | 1747,8 MHz |
| GSM1900 | Z7520 | 1880,0 MHz |


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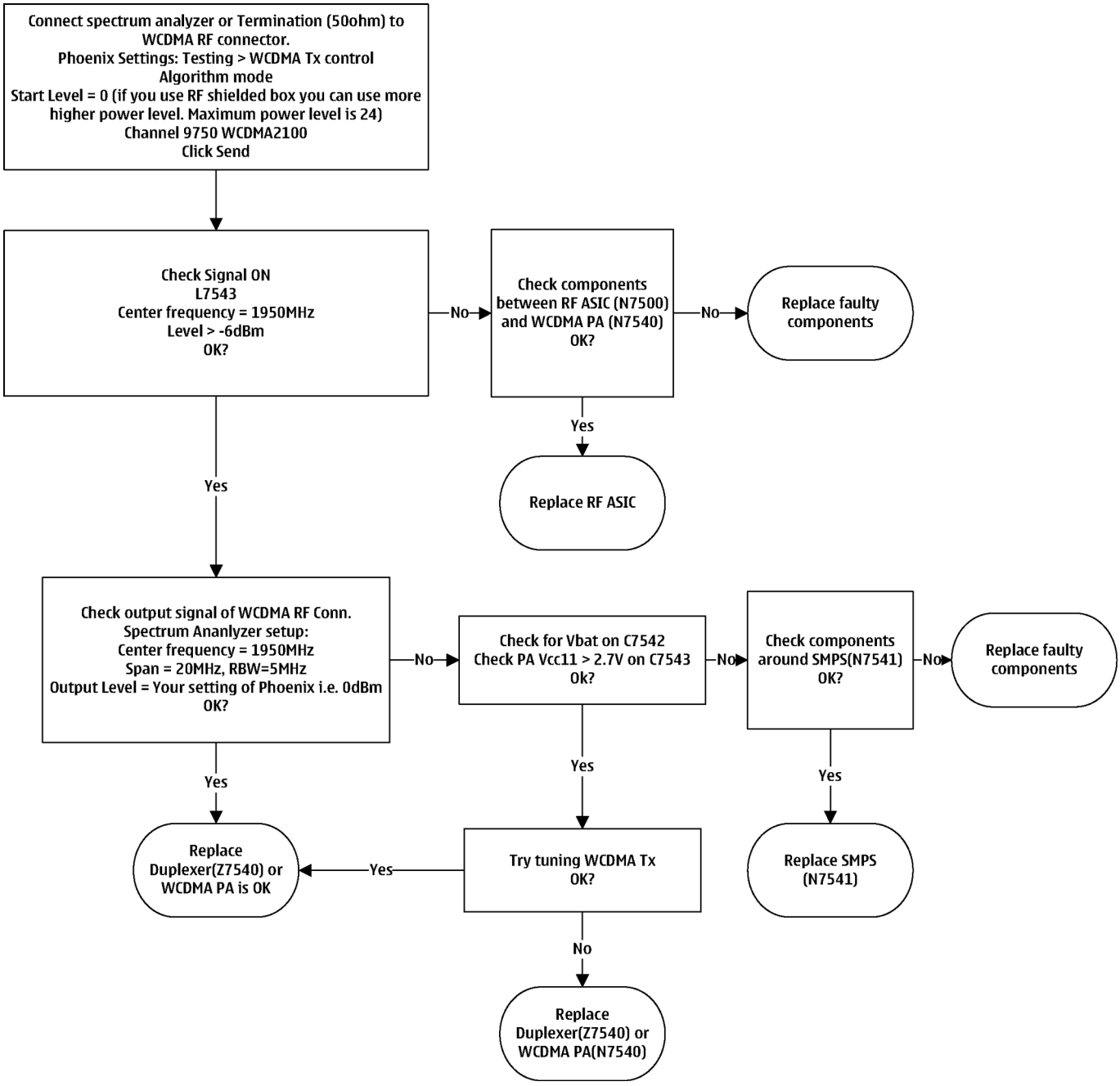
## Power amplifier (PA) and switch mode power supply (SMPS) troubleshooting

### Troubleshooting flow




## RF tunings

### Introduction to RF tunings

Phone RF is tuned in production. There is no reason to do the re-calibration unless:

- One or more of the RF components is changed
- FLASH memory chip (D5000) is changed or otherwise corrupted.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**Note:** RF calibration is always performed with the help of a product-specific module jig, never with an RF coupler. Using an RF coupler in the calibration phase will cause a complete mistuning of the RF side.

**Important:** After RF component changes, **always** use autotuning. Manual tunings are only required in rare cases.

## Cable and adapter losses

RF cables and adapters have some losses. They have to be taken into account when the phone is tuned. As all the RF losses are frequency dependent, the user have to be very careful and understand the measurement setup. The following table presents the RF attenuations of the product-specific module jig:

| Band | Attenuation |
|---|---|
| GSM900 | 0.25dB |
| GSM1800 | 0.4dB |
| GSM1900 | 0.45dB |
| WCDMA 2100 | 0.25dB |

# RF autotuning

## Prerequisites

For information on the recommended test set-up, refer to the corresponding information on the Partner Website or Nokia Online.

Before you can use the autotuning feature, the GPIB driver from the GPIB card vendor must be installed and running.

The autotune **.xml** file must be in a correct place: **C:\Program Files\Nokia\Phoenix\products\xx-x*\rfconf_xx-x*.xml** (**= indicates the type designator of the phone, e.g. RM-1*)

## Context

RF autotuning is performed with the aid of a digital radio communication tester.

Autotuning covers all RF tunings that are needed to perform after RF component repairs.

**Note:** Do not perform RF autotuning without a proper reason. Autotuning may only be performed after component repairs or if the RF tuning information is lost.

## Steps

1. Connect the communication tester to the GPIB bus.
2. Start *Phoenix* service software.
3. Choose **Tools→Options→GPIB Card.**
4. From the **Card Type** drop-down menu, choose the GPIB card used, then click **Start**.
   The name of the communication tester appears in the **Listeners** pane.


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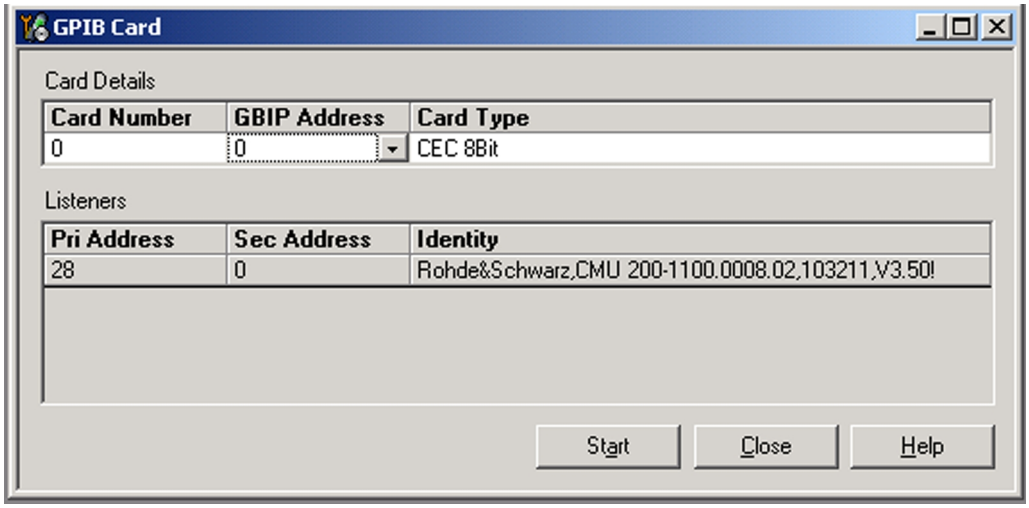
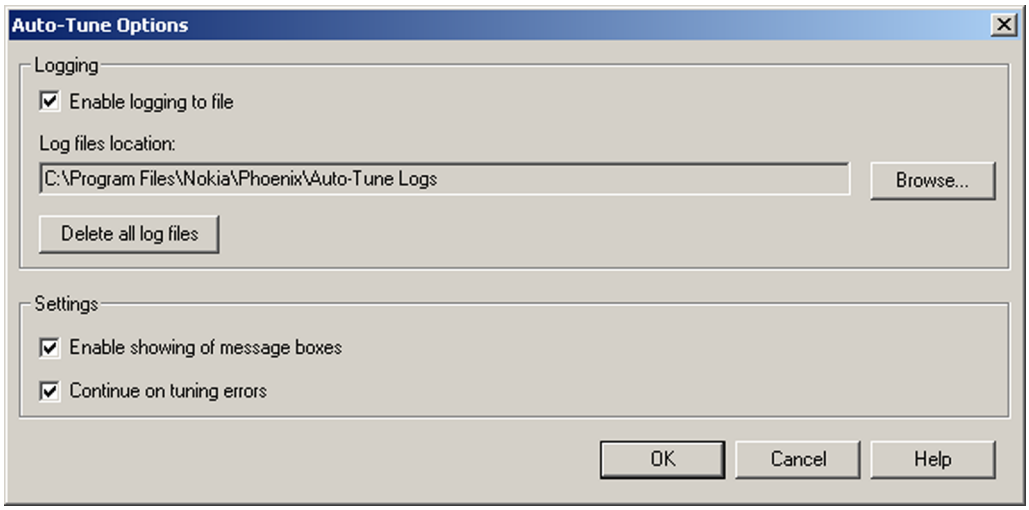



5. To specify the cable loss from a module jig to the communication tester, choose **Set Loss** from the **Tuning** menu.
6. In the *Set Loss* window, click the **Jig** tab, and select the right jig for the phone from the drop-down list. Alternatively, you can add a new jig by clicking **Add**, and selecting the desired jig from the list.
7. Click the **Cable** tab and add the extra cable attenuation.
8. Read and save tuning values from a phone just in case. In the Flashing pull-down select **RF/BB Permanent Memory Settings Preserver**. Check RF & BB & Product settings. Press **Read** and **Save** to a file
9. To start autotuning, choose **Auto-Tune** from the **Tuning** menu.
10. In the *Auto-Tune* window, click **Options**.
11. In the *Auto-Tune options* window, ensure the **Enable showing of message boxes** check box is checked, and click **OK**.





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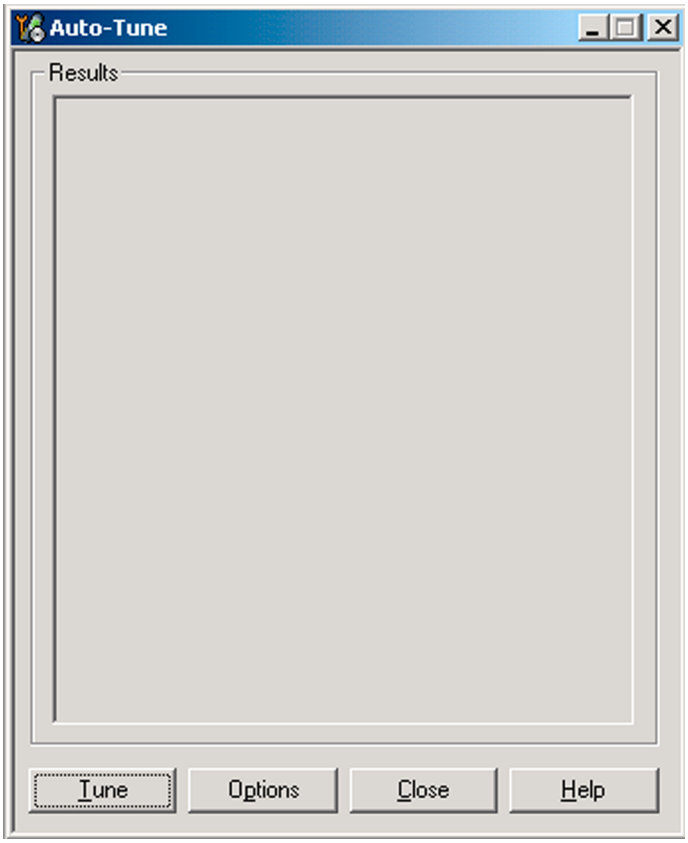
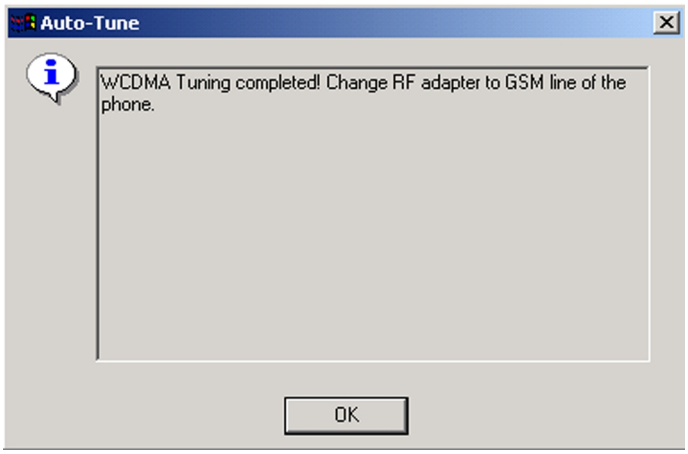
12. Connect the phone WCDMA RF port to the communication tester, and click **Tune**.




13. Change the phone RF adapter from WCDMA port to GSM port.




14. To complete the RF autotuning, click **OK**.
15. If tuning fails, restore tuning values from a saved file. In the Flashing pull-down select **RF/BB Permanent Memory Settings Preserver**. Press **Open** Select the file and press **Write**.

## Results

*Autotuning completed successfully!* message appears.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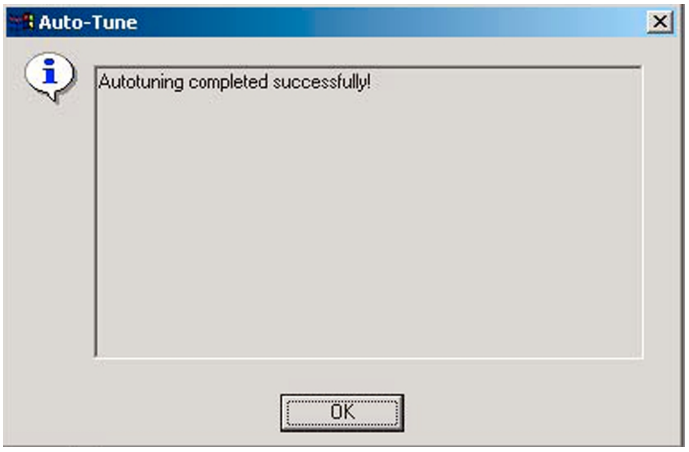


## RF manual tuning guide

### *Required manual tunings after component changes*

**Important:** After RF component changes, **always** use autotuning. Manual tunings are only required in rare cases.

If, however, manual tuning is used, only relevant tunings should be performed. Refer to the following table:

| Changed component | Perform the following tunings |
|---|---|
| RF ASIC N7500 | RF Channel Filter Calibration, Temperature Sensor Calibration, Rx calibration (GSM), Rx band filter response compensation (GSM), TxIQ Tuning (GSM), Tx Power Level Tuning (GSM), Rx calibration (WCDMA), Tx AGC & Power Detector (WCDMA), Tx Band Response Calibration (WCDMA), Tx LO Leakage (WCDMA) |
| Any component in the GSM TX RF chain before the PA | Tx IQ Tuning, Tx Power Level Tuning |
| Any component in the GSM TX RF chain after the PA or PA | Tx Power Level Tuning |
| Any component in the WCDMA TX RF chain before the PA | Tx AGC & Power Detector, Tx Band Response Calibration, Tx LO Leakage |
| Any component in the WCDMA TX RX chain after the PA, PA, power detector or PA switch mode power supply | Tx AGC & Power Detector, Tx Band Response Calibration, PA Detection |
| Any component in the GSM RX chain | Rx Calibration, RX Band Filter Response Compensation |
| Any component in the WCDMA RX chain | Rx AGC Alignment, RX Band Response Calibration |
| VCTCXO G7500 | Rx Calibration (GSM900 band) |
| WLAN Module (N6302) | WLAN Tx Tuning |


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## *System mode independent manual tunings*

### *RF channel filter calibration*

#### Context

RF channel filter calibration tunes RF ASIC's internal low pass filters that limit the bandwidth of BB IQ signals. One common calibration is made for GSM and WCDMA.

**Table 13 RF channel filter calibration tuning limits**

| | Min | Typ | Max |
|---|---|---|---|
| Tx filter | 0 | 10 | 31 |
| Rx filter | 0 | 16 | 31 |

#### Steps

1. From the "Operating mode" dropdown menu, set mode to "Local".
2. From the Tuning menu, choose "RF Channel Filter Calibration".
3. Click Tune.
4. To save the values to the PMM (Permanent Memory) area, click Write.
5. To close the tuning window, click Close.

#### Results

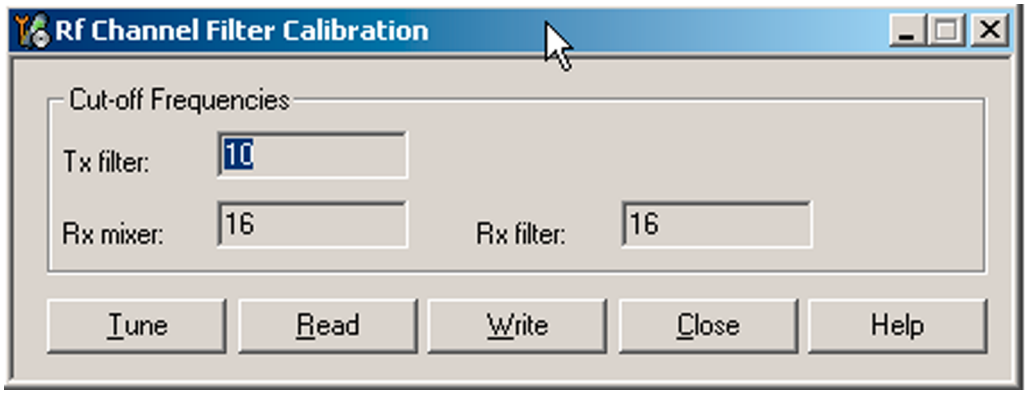


**Figure 63 RF channel filter calibration typical values**

### *PA (power amplifier) detection*

#### Context

The PA detection procedure detects which PA manufacturer is used for phone PAs.

If a PA is changed or if the permanent memory (PMM) data is corrupted, PA detection has to be performed before Tx tunings.

#### Steps

1. From the **Operating mode** drop-down menu, set mode to **Local**.
2. Choose **Tuning→PA Detection** .
3. Click **Tune**.


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4. Check that the detected PA manufacturers are corresponding to the actual chips on the board.
5. To end the procedure, click **Close**.

### *Temperature sensor calibration*

## Context

There is a temperature sensor intergrated into the RF ASIC. The RF ASIC produces a DC-voltage, which is temperature dependent.

Temperature sensor calibration is done in room temperature, in which offsets caused by variations with Rx/Tx ASIC and the AD-converter inside EM ASIC N2200, are removed.

The engine calibrates itself, no external equipment is required.

The temperature of the engine must be 23°C plus or minus two degrees.

## Steps

1. From the "Operating mode" dropdown menu, set mode to "Local".
2. From the Tuning menu, choose "Temperature Sensor Calibration".
3. Click "Tune".

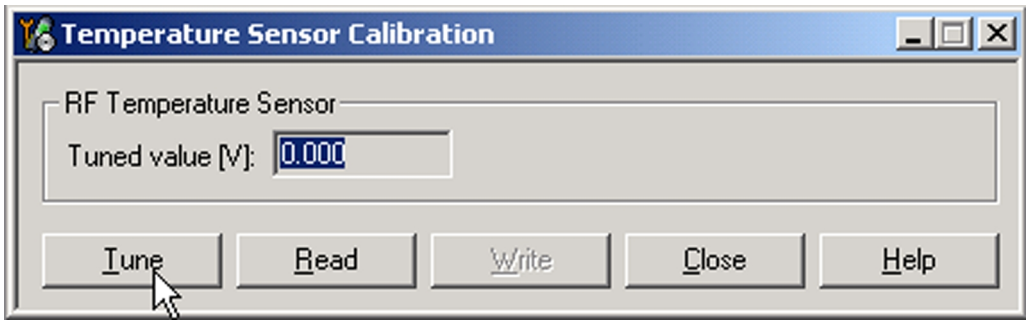


**Table 14 Temperature sensor calibration tuning limits**

| Min | Typ | Max | Unit |
|---|---|---|---|
| -20 | -4 | 20 | V |

4. To save the calibration values, click "Write".
5. To finish the calibration, click "Close".

### *GSM receiver tunings*

### *Rx calibration (GSM)*

## Context

Rx Calibration is used to find out the real gain values of the GSM Rx AGC system and tuning response of the AFC system (AFC D/A init value and AFC slope)

## Steps

1. Connect the module jig's GSM connector to signal generator.
2. From the "Operating mode" dropdown menu, set mode to "Local".


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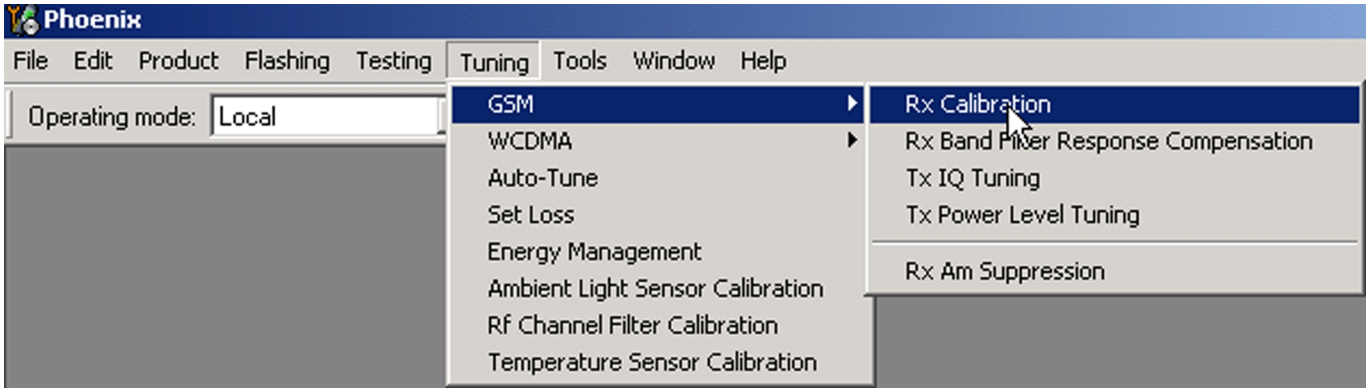
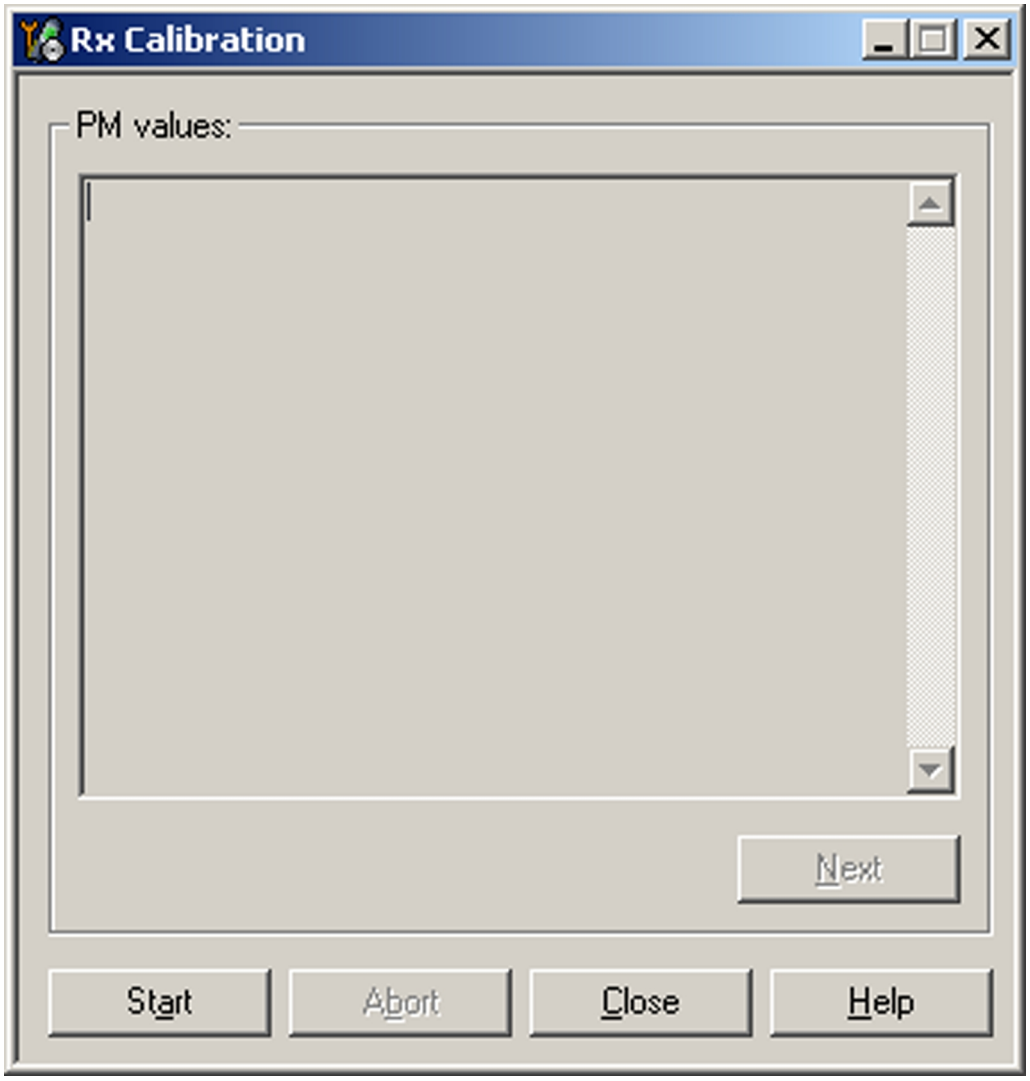
3. From the Tuning menu, choose GSM -> Rx Calibration.




4. Check the “Load from Phone” check box and clear the “Save to Phone” check box.
5. From the Band dropdown menu, choose GSM900.
6. Click Start (if not active already).




7. Click Calibrate.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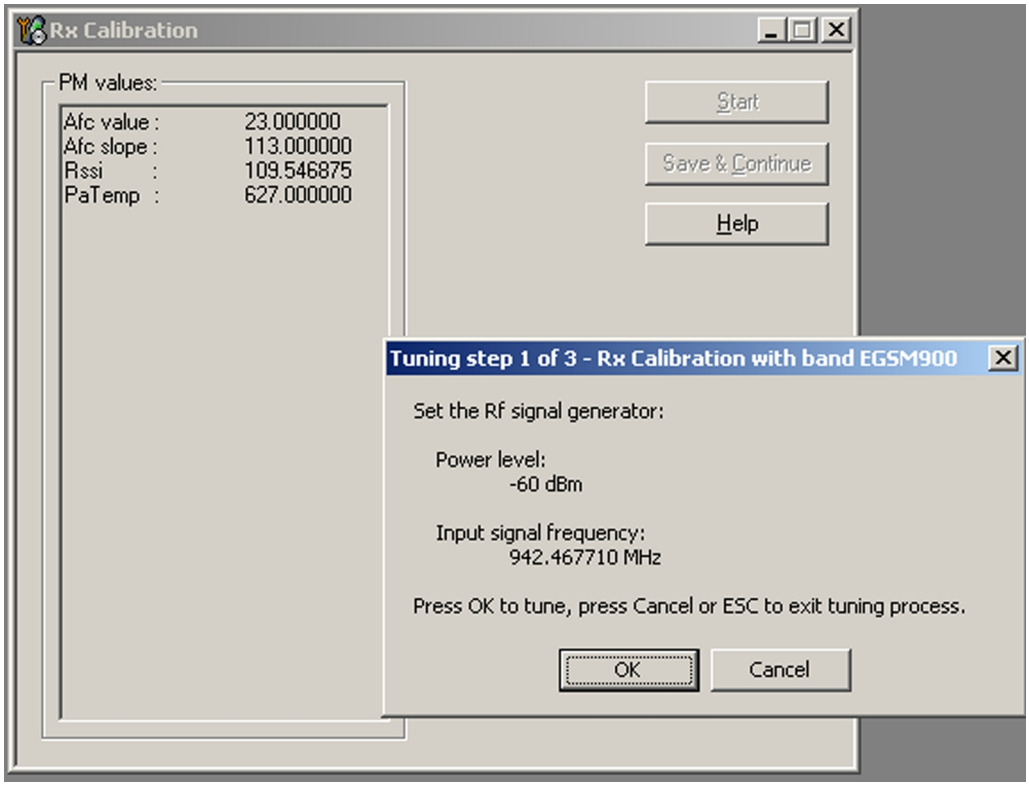
8. Connect signal generator to the phone and set frequency and amplitude as instructed in the "Rx Calibration with band EGSM900" popup window.

   The calibration uses a non-modulated CW signal. Increase the signal generator level by cable attenuation and module jig probe attenuation!




9. To perform tuning, click OK.
10. Check that the tuning values are within the limits specified in this table:

**Table 15 RF tuning limits in Rx calibration**

| | Min | Typ | Max | Unit |
|---|---|---|---|---|
| **GSM900** | | | | |
| AFC Value | -200 | -105...62 | 200 | |
| AFC slope | 0 | 122 | 200 | |
| RSSI0 | 106 | 107...110 | 114 | dB |
| **GSM1800** | | | | |
| RSSI0 | 104 | 104...109 | 114 | dB |
| **GSM1900** | | | | |
| RSSI0 | 104 | 104...109 | 114 | dB |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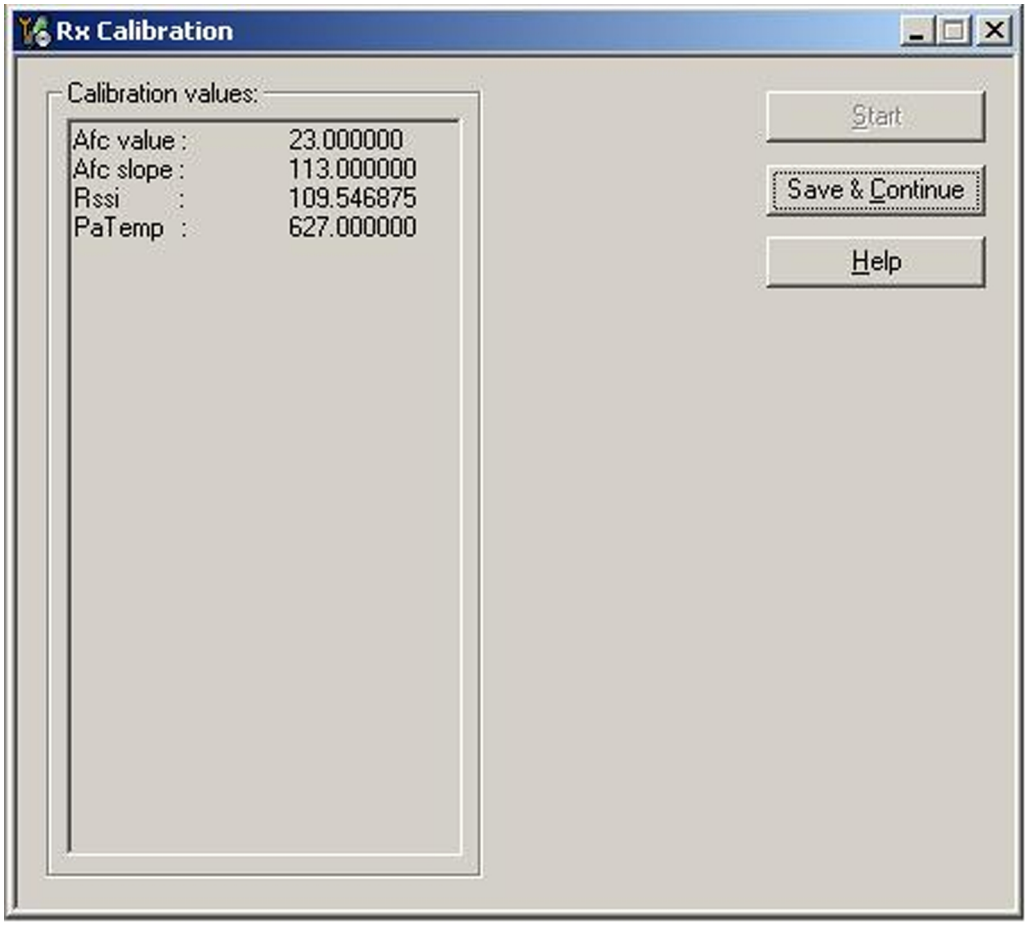
11. To save values to the phone, click "Save & Continue".




12. Repeat steps 3 to 8 for GSM1800 and GSM1900.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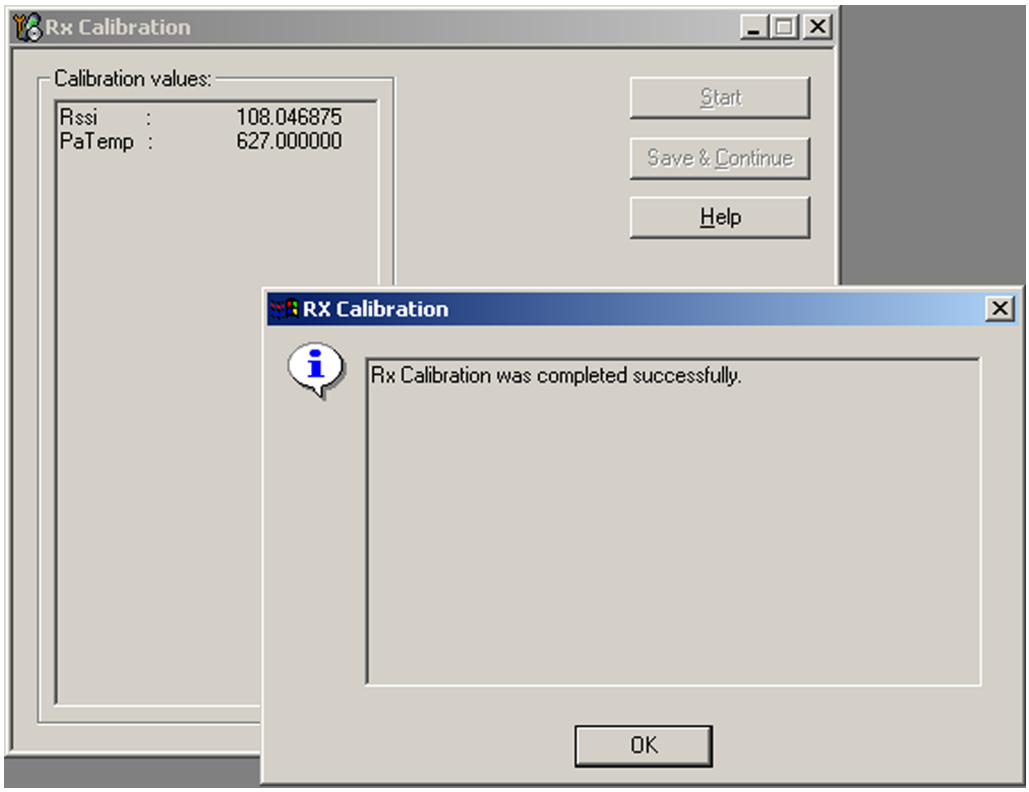
## Results




### *Rx band filter response compensation (GSM)*

## Prerequisites

Rx Calibration must be performed before the Rx Band Filter Response Compensation.

## Context

On each GSM Rx band, there is a band rejecting filter in front of the LNA (Low Noise Amplifier). In RM-100, the filter is integrated in RF ASIC N7500. The amplitude ripple caused by these filters causes ripple to the RSSI measurement and therefore calibration is needed.

The calibration has to be repeated for each GSM band.

## Steps

1. Connect the module jig's GSM connector to the signal generator.
2. From the "Operating mode" dropdown menu, set mode to "Local".
3. Select GSM900 band.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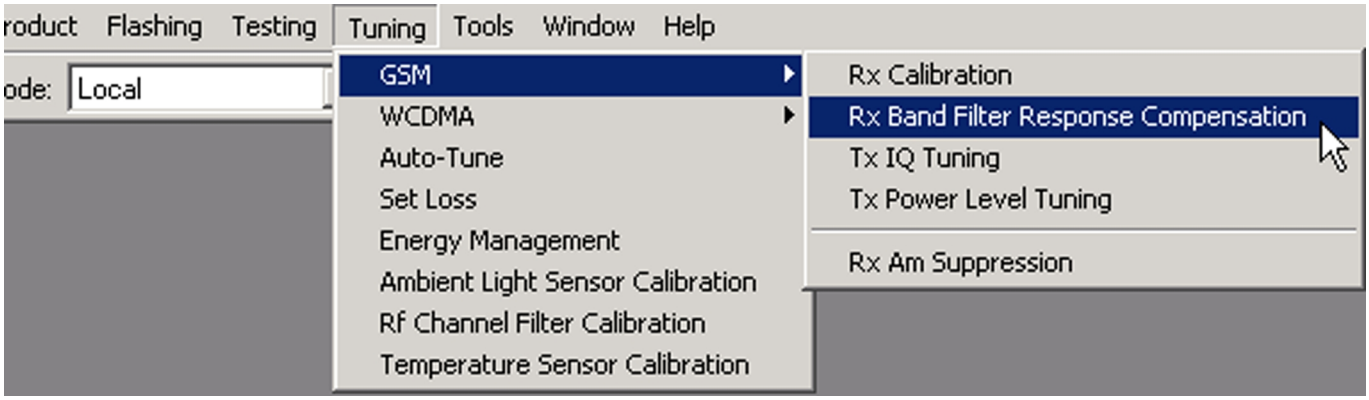
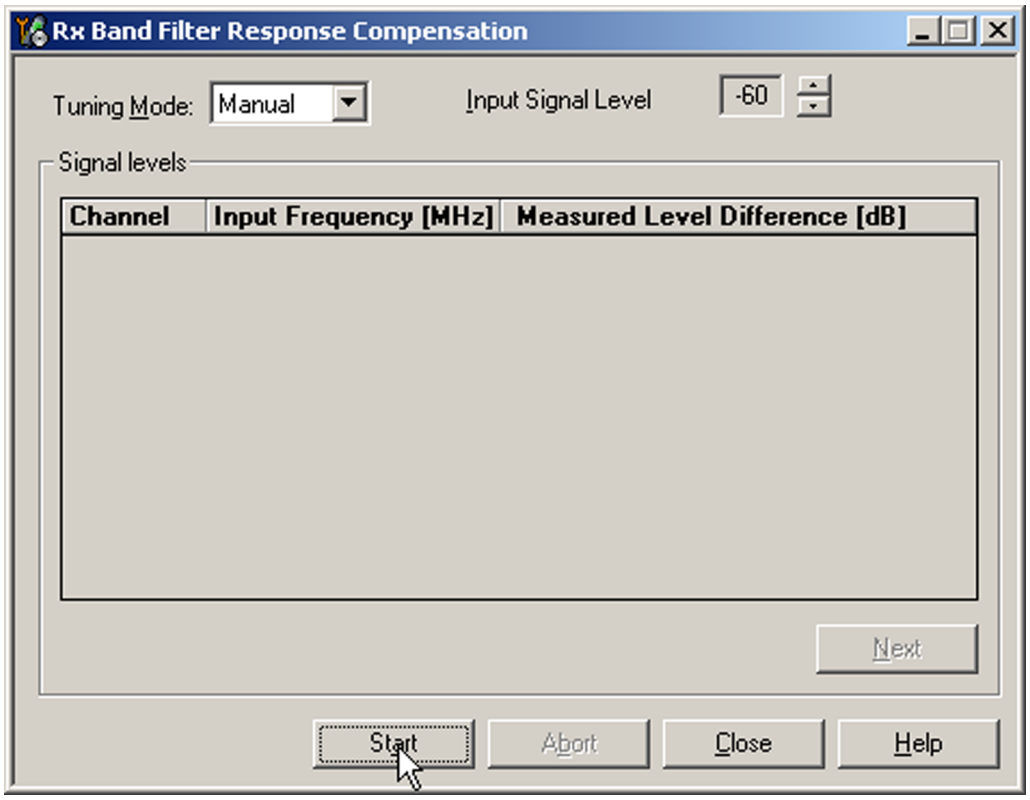
4. From the Tuning menu, choose GSM -> Rx Band Filter Response Compensation.




5. In the *Tuning mode* pane, select **Manual**.
6. Click Start.





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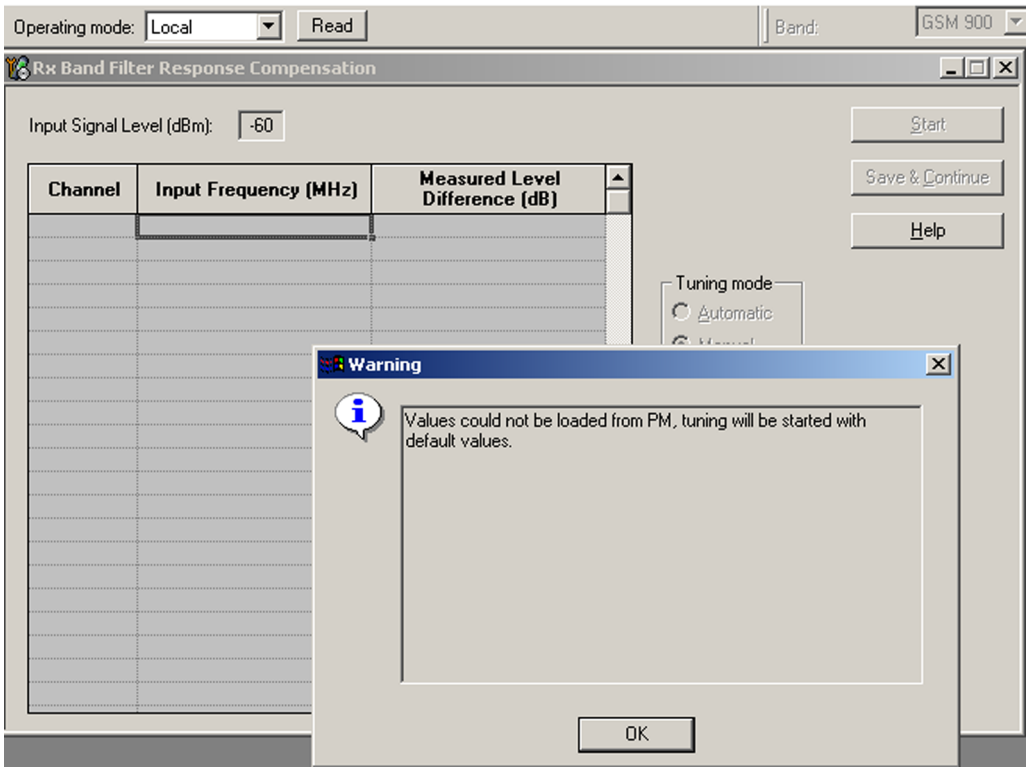
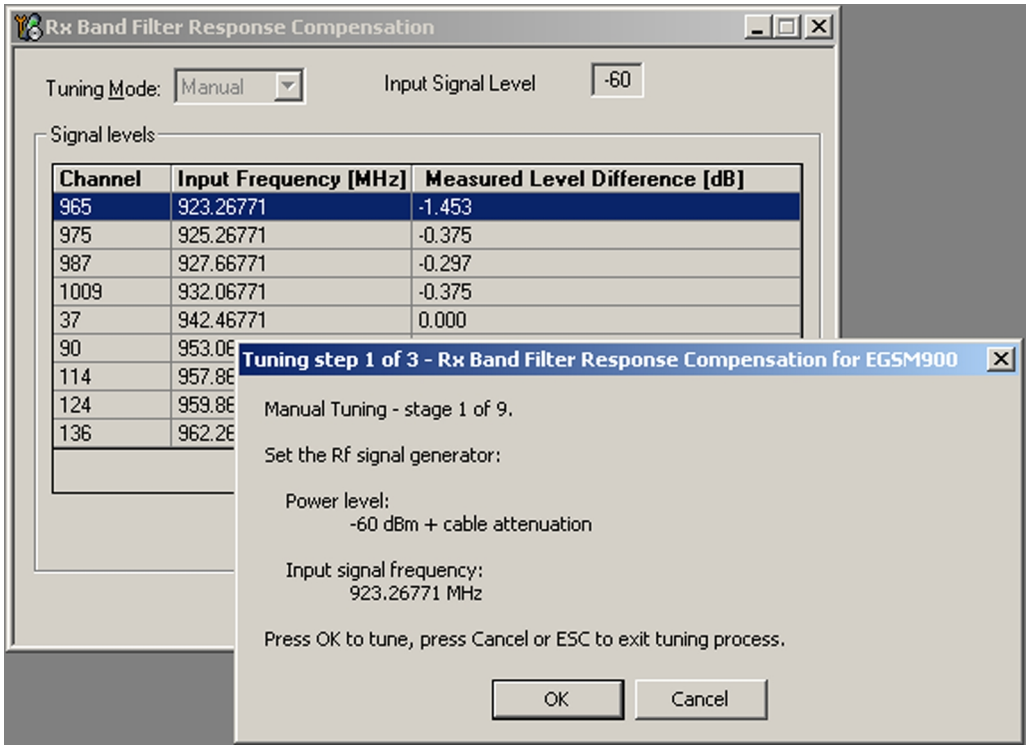
7. Click *Save & Continue*.




8. Connect the signal generator to the phone and set frequency and amplitude as instructed in the "Rx Band Filter Response Compensation for EGSM900" popup window.




9. To perform tuning, click OK.
10. Go through all 9 frequencies.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11. Check that the tuning values are within the limits specified in the following table:

| | Min | Typ | Max | Unit |
|---|---|---|---|---|
| **GSM900** | | | | |
| Ch. 965 / 923.26771 MHz | -10 | -1 | 5 | dB |
| Ch. 975 / 925.26771 MHz | -3 | 0 | 5 | dB |
| Ch. 987 / 927.66771 MHz | -3 | 0 | 5 | dB |
| Ch. 1009 / 932.06771 MHz | -3 | 0 | 5 | dB |
| Ch. 37 / 942.46771 MHz | -3 | 0 | 5 | dB |
| Ch. 90 / 953.06771 MHz | -3 | 0 | 5 | dB |
| Ch. 114 / 957.86771 MHz | -3 | 0 | 5 | dB |
| Ch. 124 / 959.86771 MHz | -3 | 0 | 5 | dB |
| Ch. 136 / 962.26771 MHz | -10 | -1 | 5 | |
| **GSM1800** | | | | |
| Ch. 497 / 1802.26771 MHz | -10 | -1 | 5 | dB |
| Ch. 512 / 1805.26771 MHz | -3 | 0 | 5 | dB |
| Ch. 535 / 1809.86771 MHz | -3 | 0 | 5 | dB |
| Ch. 606 / 1824.06771 MHz | -3 | 0 | 5 | dB |
| Ch. 700 / 1842.86771 MHz | -3 | 0 | 5 | dB |
| Ch. 791 / 1861.06771 MHz | -3 | 0 | 5 | dB |
| Ch. 870 / 1876.86771 MHz | -3 | 0 | 5 | dB |
| Ch. 885 / 1879.86771 MHz | -3 | 0 | 5 | dB |
| Ch. 908 / 1884.46771 MHz | -10 | -1 | 5 | dB |
| **GSM1900** | | | | |


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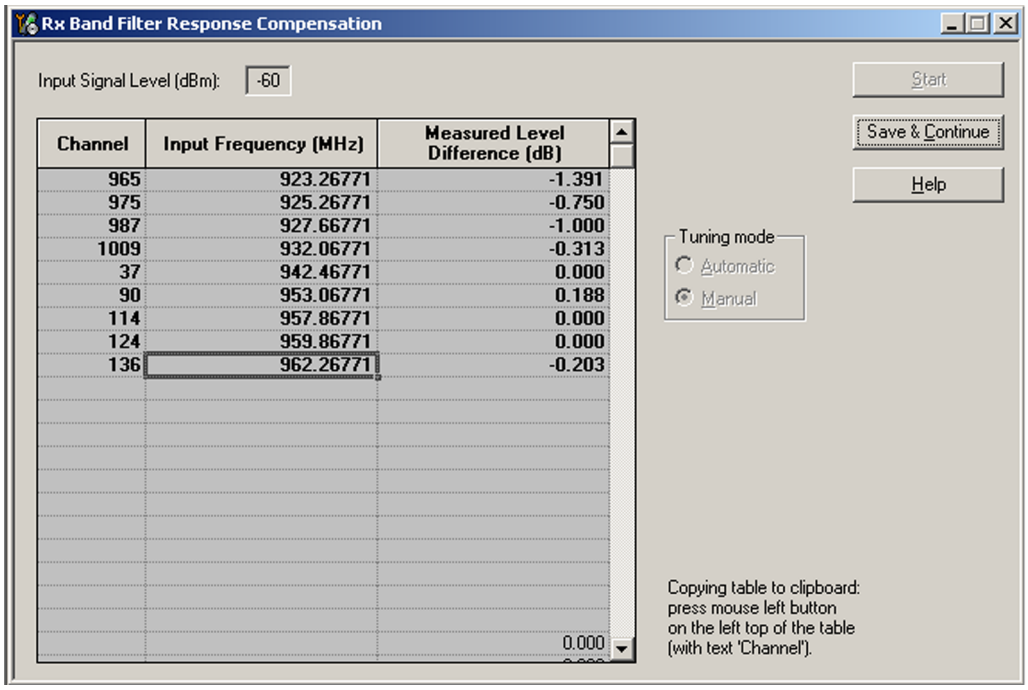
| | Min | Typ | Max | Unit |
|---|---|---|---|---|
| Ch. 496 / 1927.06771 MHz | -10 | -1 | 5 | dB |
| Ch. 512 / 1930.26771 MHz | -3 | 0 | 5 | dB |
| Ch. 537 / 1935.26771 MHz | -3 | 0 | 5 | dB |
| Ch. 586 / 1945.06771 MHz | -3 | 0 | 5 | dB |
| Ch. 661 / 1960.06771 MHz | -3 | 0 | 5 | dB |
| Ch. 736 / 1975.06771 MHz | -3 | 0 | 5 | dB |
| Ch. 794 / 1986.66771 MHz | -3 | 0 | 5 | dB |
| Ch. 810 / 1989.86771 MHz | -3 | 0 | 5 | dB |
| Ch. 835 / 1994.86771 MHz | -10 | -1 | 5 | dB |

12. If the values are within the limits, click "Save & Continue".




13. Repeat the steps 4 to 10 for GSM1800 and GSM1900.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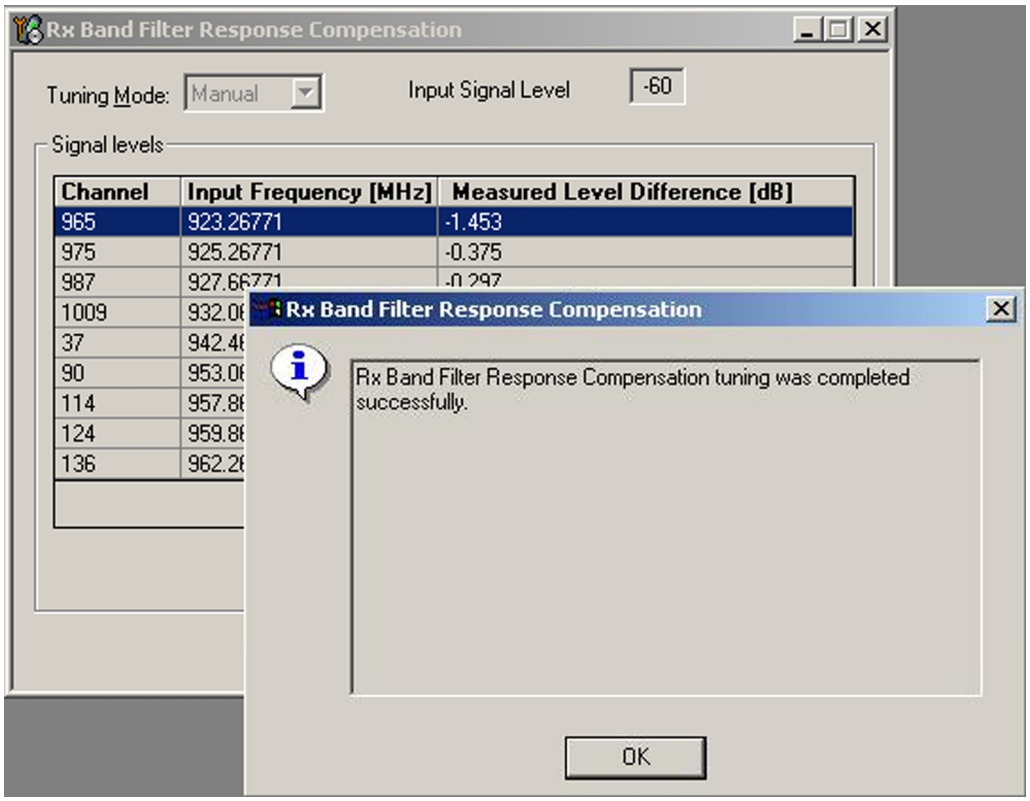
## Results




### *GSM transmitter tunings*

### *Tx IQ tuning (GSM)*

## Context

- The Tx path branches to I and Q signals at RF I/Q modulator. Modulator and analog hardware located after it cause unequal amplitude and phase disturbance to I and Q signal paths. Tx IQ tuning balances the I and Q branches.
- Tx IQ tuning must be performed on all GSM bands.

## Steps

1. From the dropdown menus, set "Operating mode" to Local, "System mode" to GSM, and "Band" to GSM900.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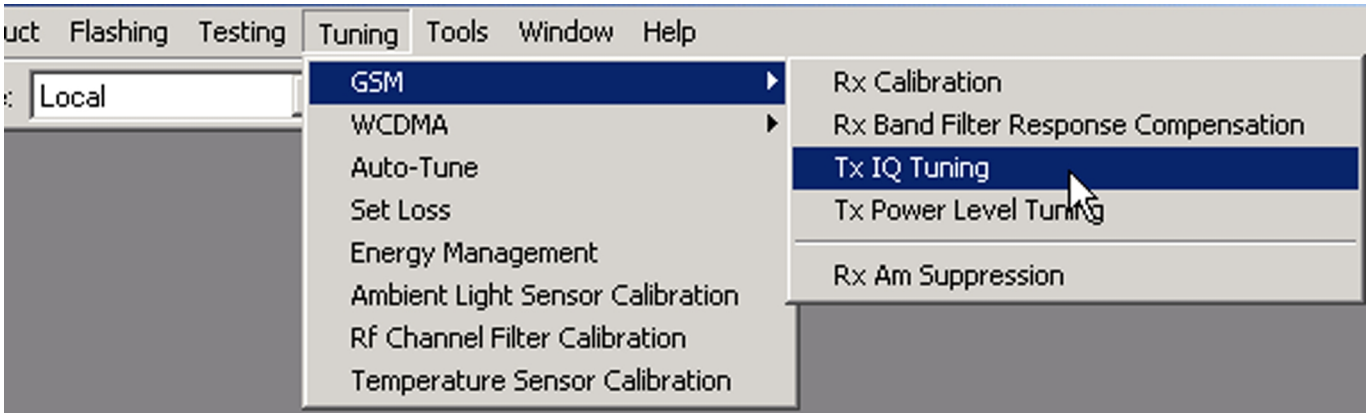
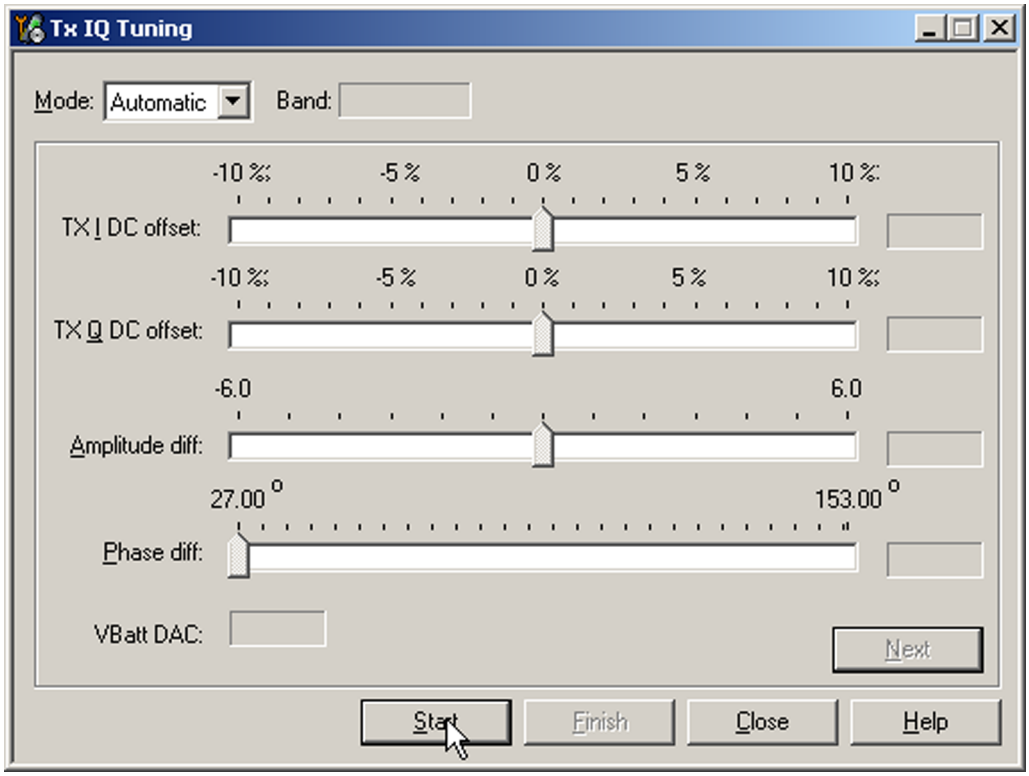
2. From the Tuning menu, choose GSM -> Tx IQ Tuning.




3. Set "Mode" to Automatic and "Edge" to Off.
4. Click Start.
   Wait until automatic tuning has finished and moved the sliders.
   Values are written to the phone memory automatically.





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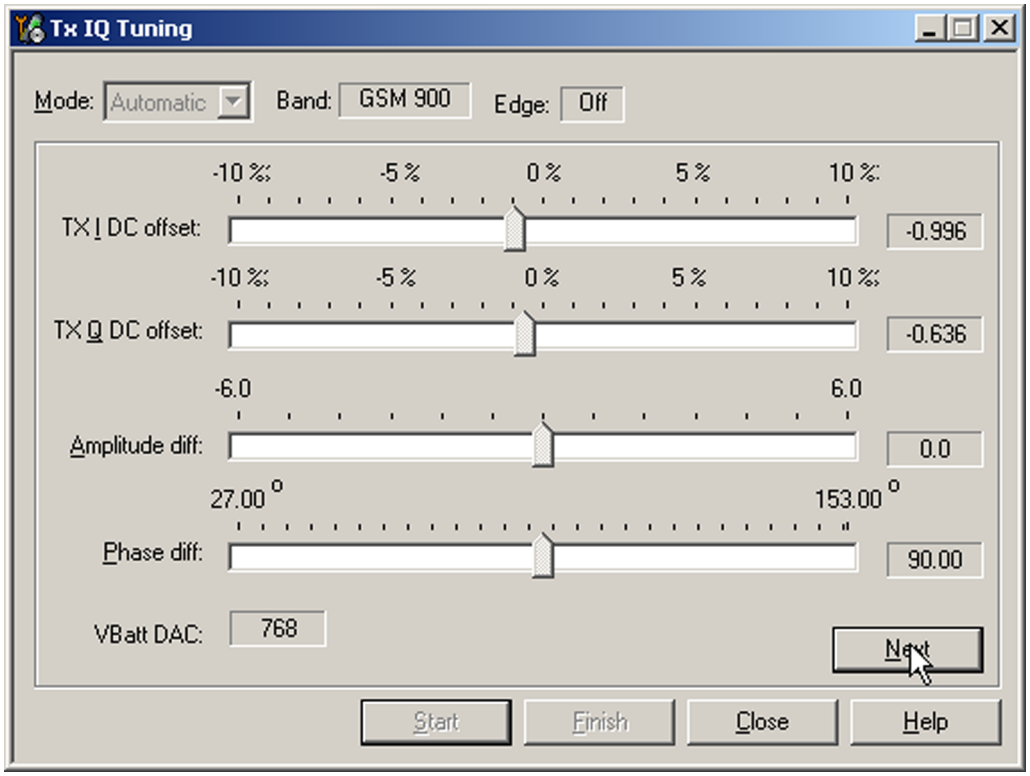
5. When the values have been written to the phone memory, click Next to change to the next band.




6. When all bands have been tuned, click Finish and Close to end the tuning procedure.

## Next actions

Tuning sliders should be close to the center of the scale after the tuning and within the limits specified in the following table. If they are not within the limits, check Tx IQ quality manually.

| | Min | Typ | Max | Unit |
|---|---|---|---|---|
| **GSM900** | | | | |
| I DC offset / Q DC offset | -6 | -4 4 | 6 | dB |
| Ampl | -1 | 0 | 1 | dB |
| Phase | 85 | 90 | 95 | dB |
| **GSM1800/GSM1900** | | | | |
| I/Q DC | -6 | 0.5 | 6 | dB |
| Ampl | -1 | 0 | 1 | dB |
| Phase | 95 | 100 | 110 | dB |

## *Tx power level tuning (GSM)*

## Context

Because of variations at IC process and discrete component values, the actual transmitter RF gain of each phone is different. Tx power level tuning is used to find out mapping factors called 'power coefficients'. These adjust the GSM transmitter output power to fulfill the specifications.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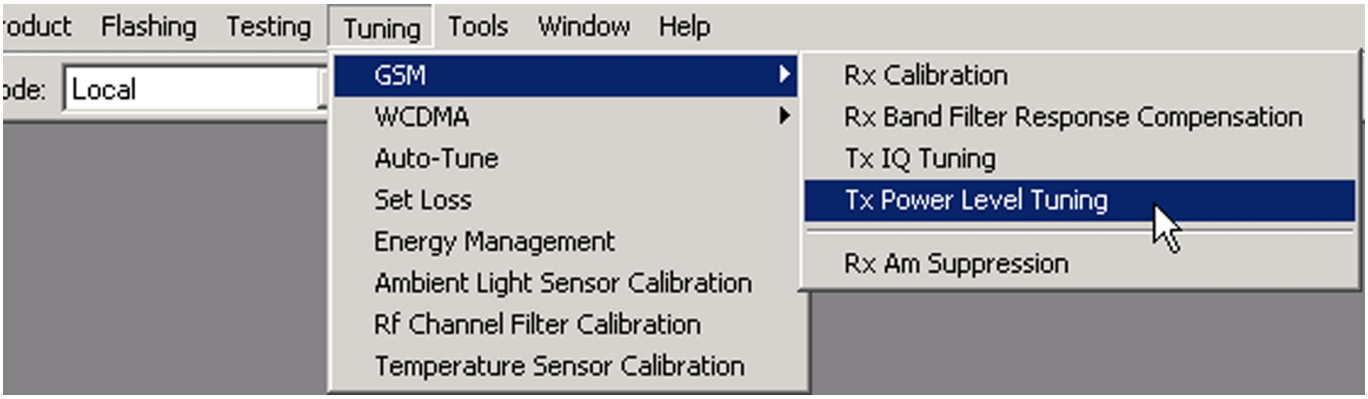
For EDGE transmission the bias settings of the GSM PA are adjusted in order to improve linearity. This affects the PA gain and hence the power levels have to be aligned separately for EDGE transmission.

Tx power level tuning has to be performed on all GSM bands.

## Steps

1. Connect the phone to a power meter with peak power detector or Agilent VSA Transmitter Tester.
2. Start Phoenix service software.
3. From the "Operating mode" dropdown menu, set mode to "Local".
4. From the Tuning menu, choose GSM -> Tx Power Level Tuning.




5. If you are using an Agilent VSA use the settings in the table below.

| Agilent VSA Transmitter Tester specific settings | |
|---|---|
| GSM900 Frequency (MHz) | 897.4 |
| GSM1800 Frequency (MHz) | 1747.8 |
| GSM1900 Frequency (MHz) | 1880 |
| Resolution Bandwidth (MHz) | 3 |
| Video Bandwidth (MHz) | 3 |
| Trigger | Video |
| Sweeptime (ms) | 1 |
| Span | zero |
| Average (for non-EDGE) | 10 |
| Average (for EDGE) | 50 |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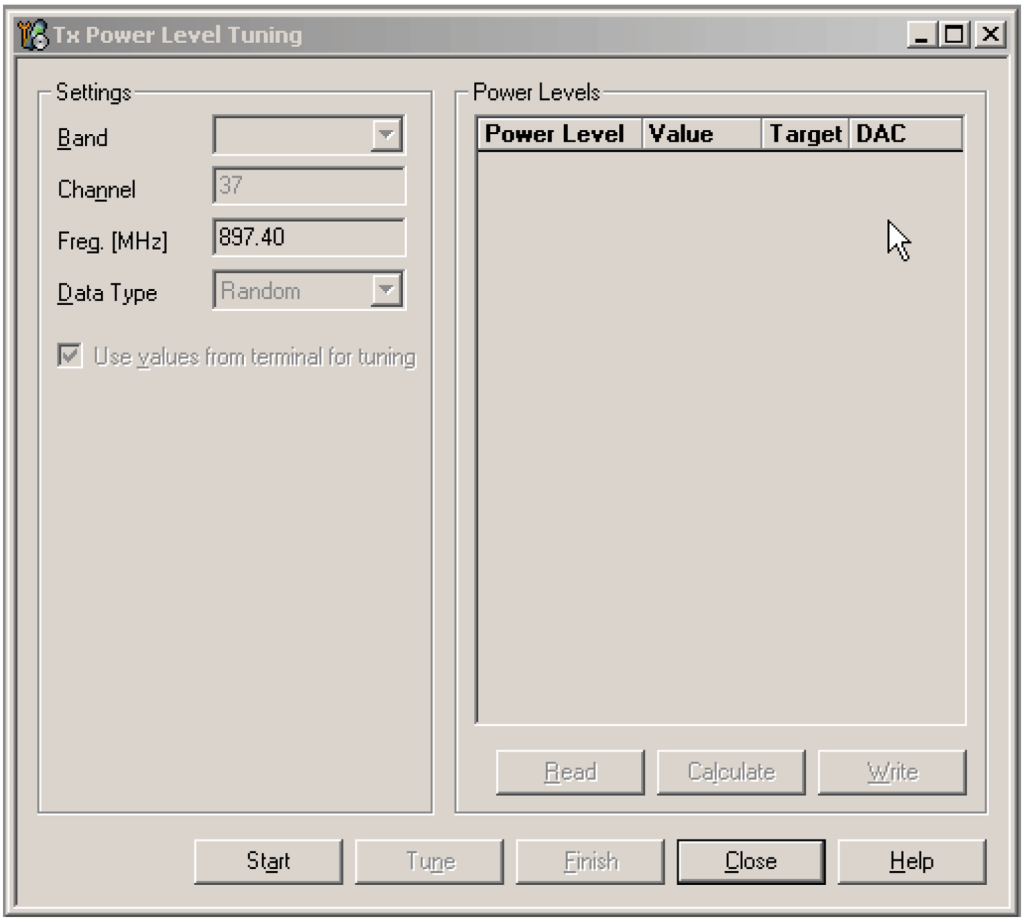
6. Click Start.




7. Select band. Set power meter or VSA to the correct frequency. Click Read and then Tune.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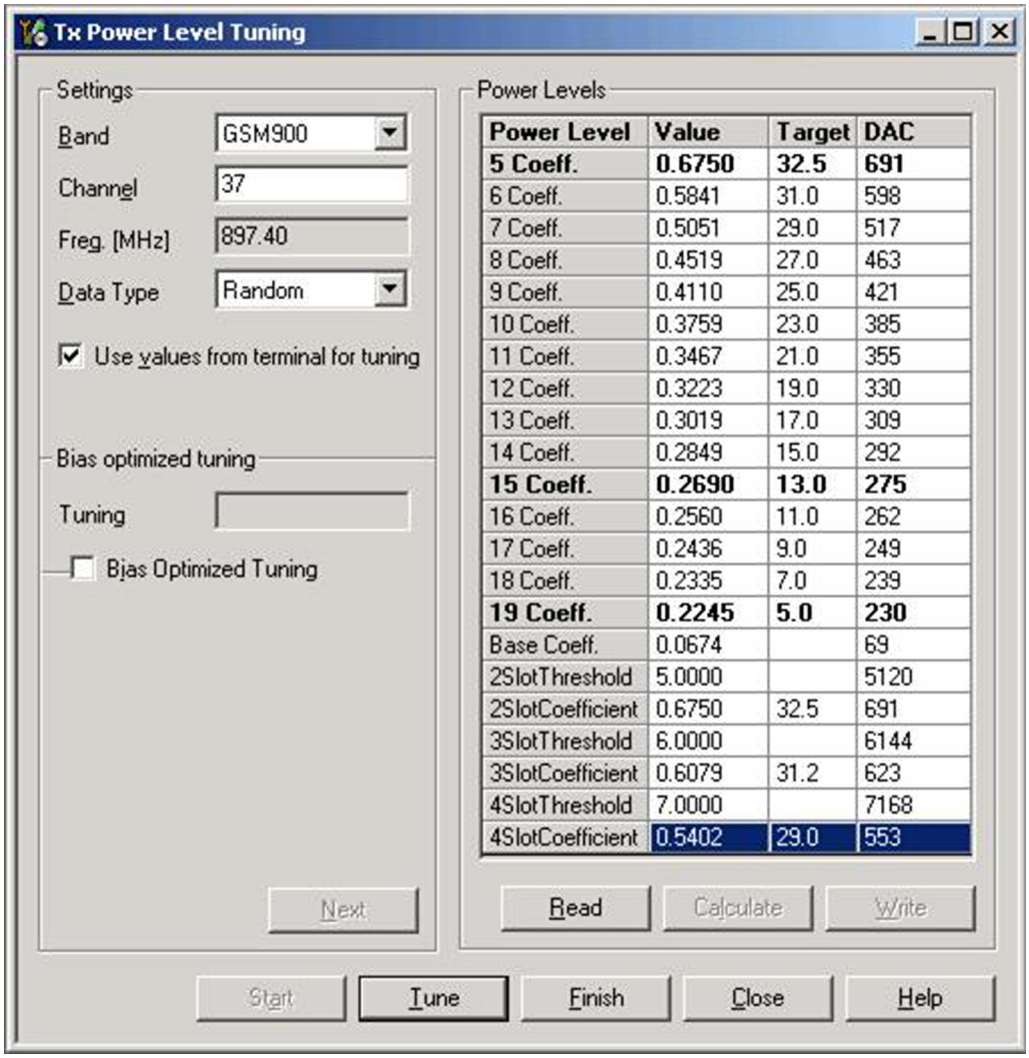
8. Adjust power levels **5**, **15** and **19** to correspond the "Target dBm" column by pressing + or – keys.




Check that the coeffiecient values are within the limits specified in the following table.

| | Min | Typ | Max |
|---|---|---|---|
| **GSM900** | | | |
| PL5 coefficient | 0.55 | 0.67 | 0.80 |
| PL15 coefficient | 0.15 | 0.22 | 0.35 |
| PL19 coefficient | 0.10 | 0.17 | 0.30 |
| **GSM900 EDGE** | | | |
| PL8 coefficient | 0.35 | 0.36 | 0.55 |
| PL15 coefficient | 0.15 | 0.24 | 0.35 |
| PL19 coefficient | 0.10 | 0.17 | 0.30 |
| **GSM1800** | | | |
| PL0 coefficient | 0.45 | 0.59 | 0.70 |
| PL11 coefficient | 0.10 | 0.17 | 0.30 |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| | Min | Typ | Max |
|---|---|---|---|
| PL15 coefficient | 0.05 | 0.13 | 0.25 |
| **GSM1800 EDGE** | | | |
| PL2 coefficient | 0.35 | 0.44 | 0.55 |
| PL11 coefficient | 0.10 | 0.18 | 0.30 |
| PL15 coefficient | 0.05 | 0.14 | 0.25 |
| **GSM1900** | | | |
| PL0 coefficient | 0.45 | 0.58 | 0.70 |
| PL11 coefficient | 0.10 | 0.17 | 0.35 |
| PL15 coefficient | 0.05 | 0.13 | 0.25 |
| **GSM1900 EDGE** | | | |
| PL2 coefficient | 0.30 | 0.44 | 0.60 |
| PL11 coefficient | 0.10 | 0.19 | 0.35 |
| PL15 coefficient | 0.05 | 0.15 | 0.25 |

9. If the values are within the limits, click "Calculate,Write & Finish". Repeat steps 7 to 9. for each band that needs tuning.
10. When tuning EDGE with the VSA use 50 averages and 10 averages for non-EDGE.
11. Tune EDGE power levels to the corresponding target power levels.

    Only power levels **8**, **15** and **19** are tuned in GSM900 and **2**, **10** and **15** in GSM1800/1900.
12. When the tuning is completed, close the Tx Power Level Tuning window.

## *WCDMA receiver tunings*

## *RX calibration (WCDMA)*

### Context

Rx calibration tuning routine calculates the real gain values of the WCDMA Rx AGC system. There is also a SAW filter between front end LNA and mixer in the receive chain, which causes ripple in the RSSI measurement, this is calibrated out. The SAW filter is intergated into RF ASIC N7500.

Rx calibration can be done in two different ways, manual tune and sweep mode tune. If the signal generator in use supports frequency sweep table, the calibration is done in one step.

### Steps

1. For manual tuning, set mode to **Local** in the **Operating Mode** dropdown menu.
2. In the **Tuning** menu, choose **WCDMA→Rx Calibration** .
3. Click **Start**.
4. Select Band "WCDMA 2100".
5. Click **Tune**.


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6. Setup the signal generator to correspond with the values on the, *Rx Calibration* pop-up window and click **OK**.

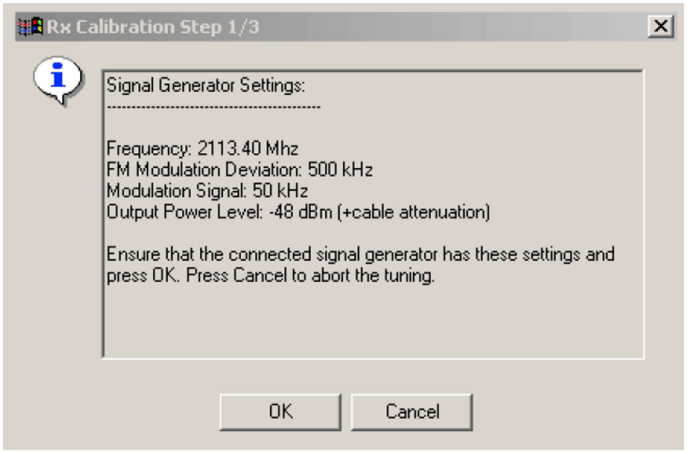
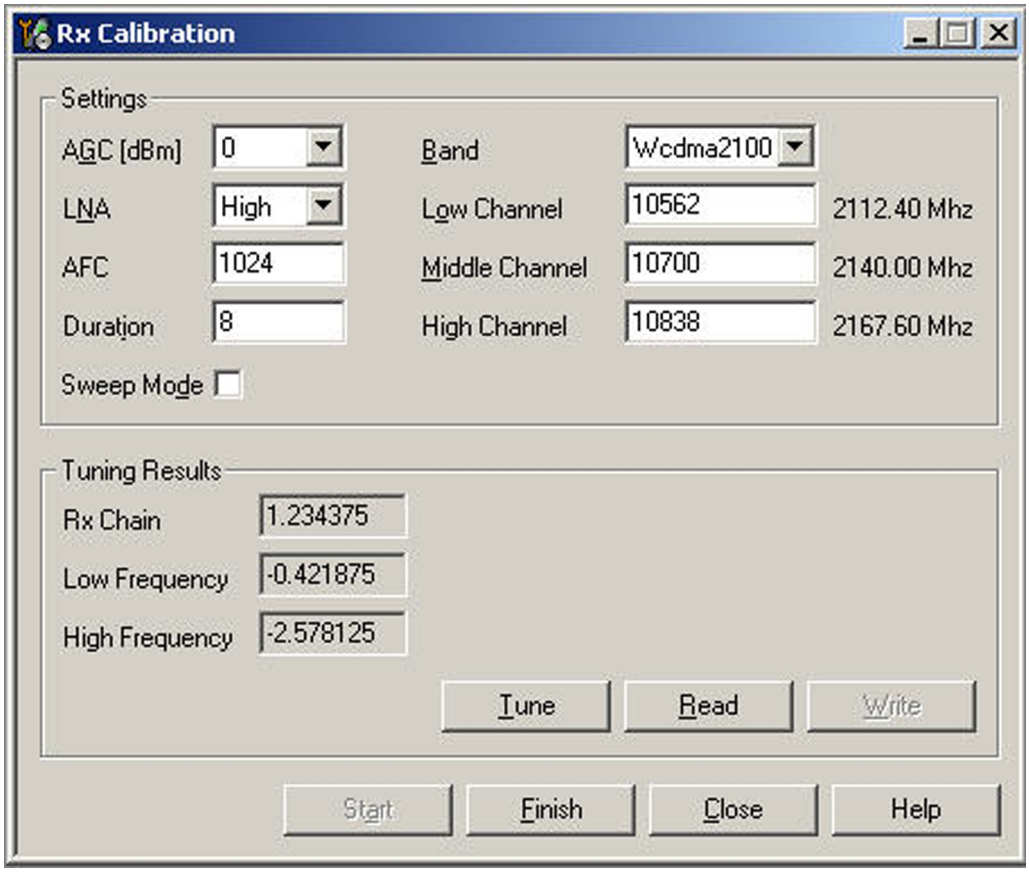



**Figure 64 Pop-up window for WCDMA2100**

7. Repeat step 6. for Middle and High channels.




8. Ensure Tuning Results are within limits specified in the table below:
   If values are OK, click **Write** to save the values.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| | Band | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Rx chain | 2100 | -6 | 1.5 to 3.5 | 6 | dB |
| Low Frequency | | -5 | -0.7 to 4.0 | 5 | |
| High Frequency | | -5 | -0.7 to 4.0 | 5 | |

## Alternative steps

- For sweep mode tuning, set **Mode** to **Local** in the **Operating Mode** dropdown menu.
- In the **Tuning** menu, choose **WCDMA→ Rx Calibration** .
- Click **Start**.
- Select **Band**, "WCDAM2100".
- Check the **Sweep Mode** box.
- Click **Tune**.
- Setup the signal generator to correspond with the values on the *Rx Calibration* pop-up window and click **OK**.

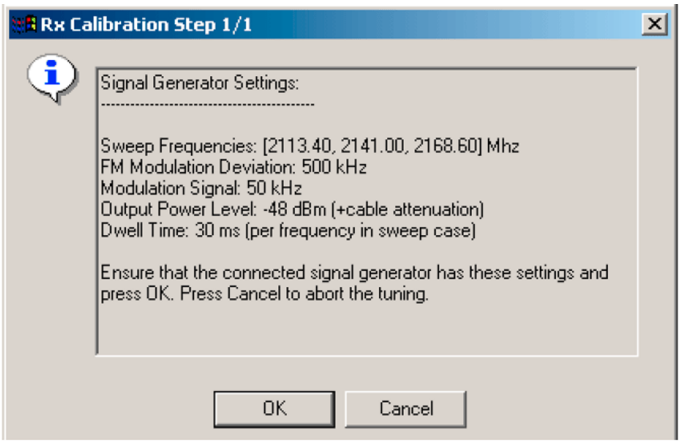


**Figure 65 Pop-up window for WCDMA2100**

- Ensure Tuning Results are within limits specified in the table above: If values are OK, click **Write** to save the values to the phone.
- Close the tuning window.

## *WCDMA transmitter tunings*

## *Tx AGC & power detector (WCDMA)*

## Context

Tx AGC & power detector tuning has two purposes:

- to enable the phone to select the correct TxC value accurately in order to produce the required RF level
- to enable the phone to measure its own transmitter power accurately

There are two ways to perform the tuning. For an alternative method, see Alternative steps (page 7–53).

## Steps

1. From the **Operating mode** drop-down menu, set mode to **Local**.


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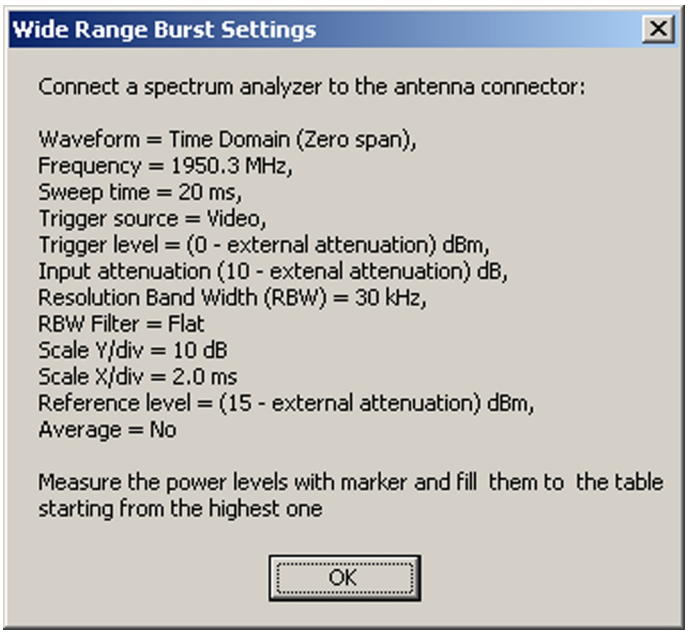
2. Choose **Tuning→WCDMA→Tx AGC & Power Detector.**
3. Click **Start**.
4. In the *Wide Range* pane, click **Tune** (the leftmost **Tune** button).
5. Set up the spectrum analyzer in the following way:




6. After setting the spectrum analyzer, click **OK**.
7. Measure the power levels with a marker.

   Take the first measurement from 250 us after the trigger, the second after 750 us, the third after 1220 us and so on for every 500 us until the table is filled.

   **Note:** It must be possible to measure power levels down to –68 dBm. The measured power levels must be monotonously decreasing.

   Make sure that the marker is not measuring the level of noise spikes on lower levels.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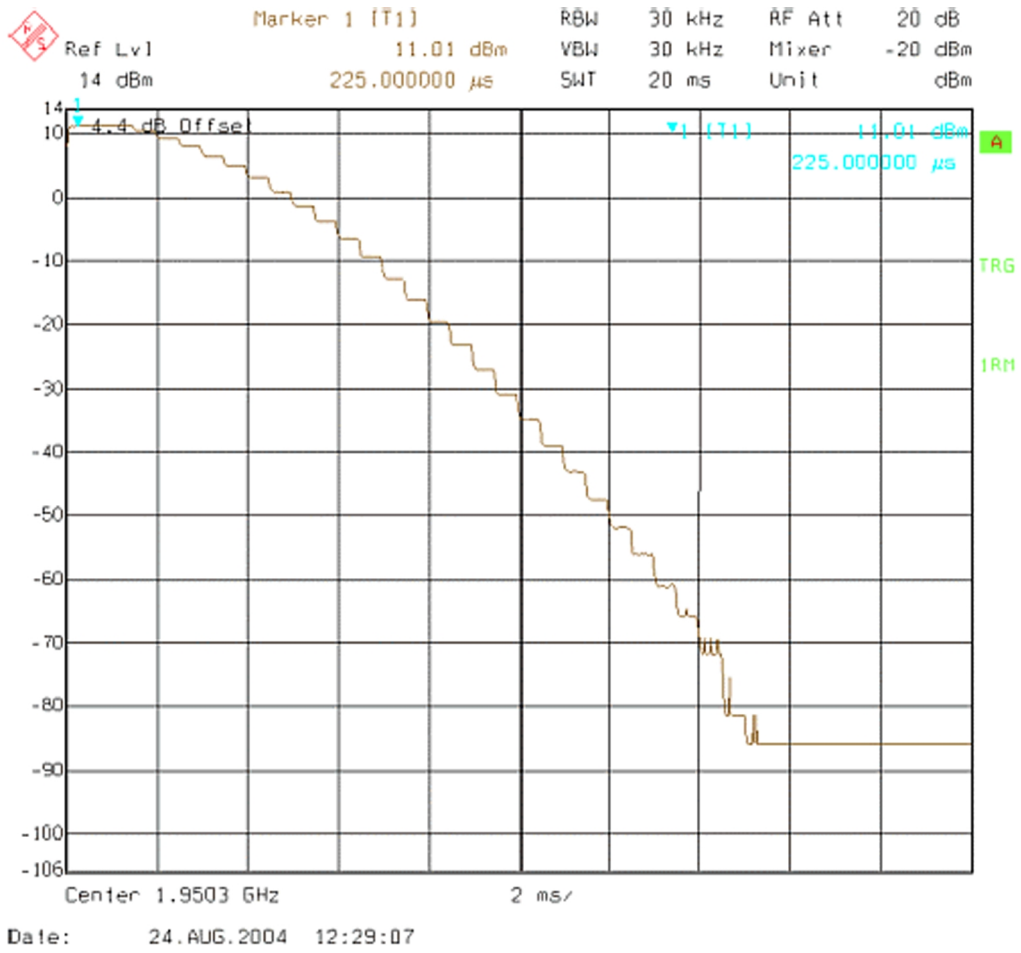



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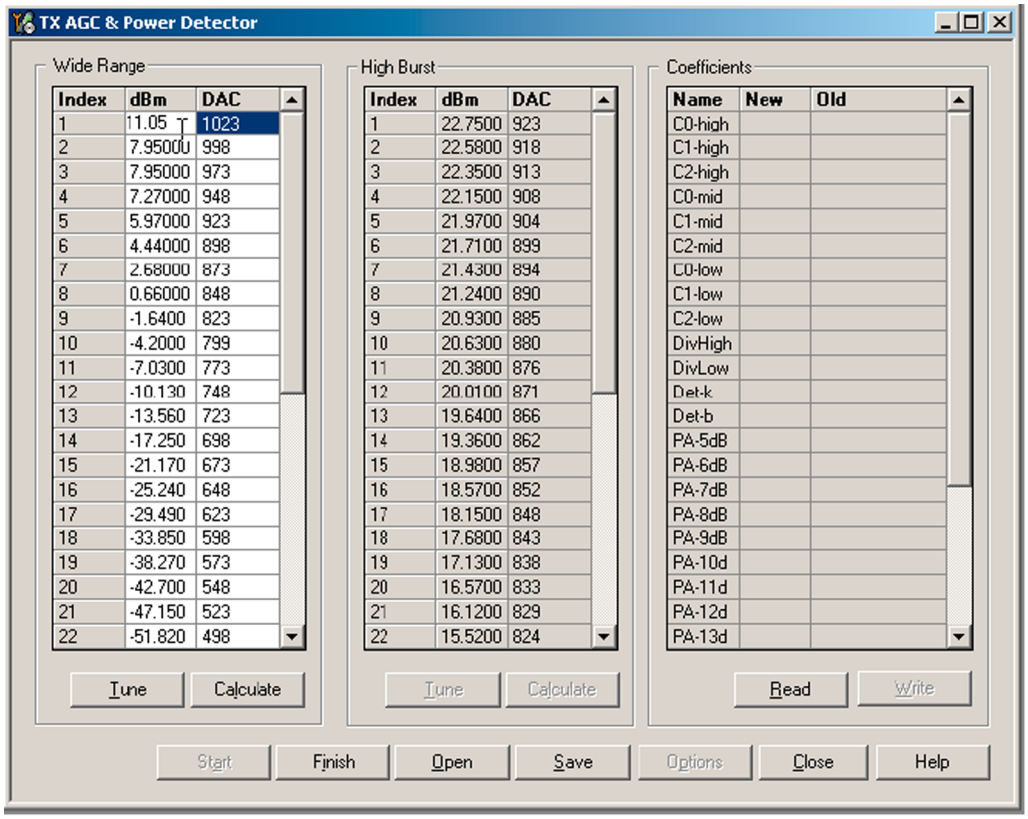
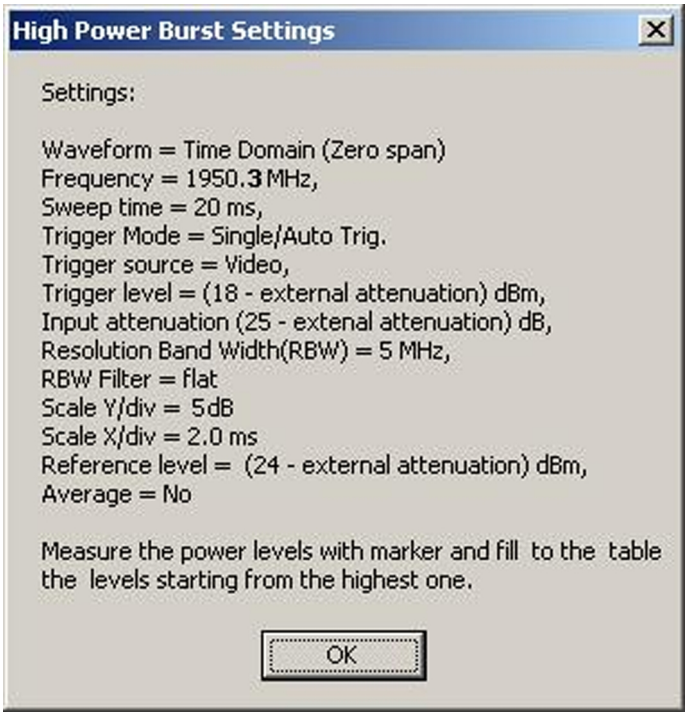
8. Fill in the power level values (in dBm) to the *Wide Range* table.




9. In the *Wide Range* pane, click **Calculate**.
10. In the *High Burst* pane, click **Tune**.
11. Adjust the spectrum analyzer according to the following settings:





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12. Measure the power levels with a marker.

    Take the first measurement from 250 us after the trigger, the second after 750 us, the third after 1220 us and so on for every 500 us until the table is filled.

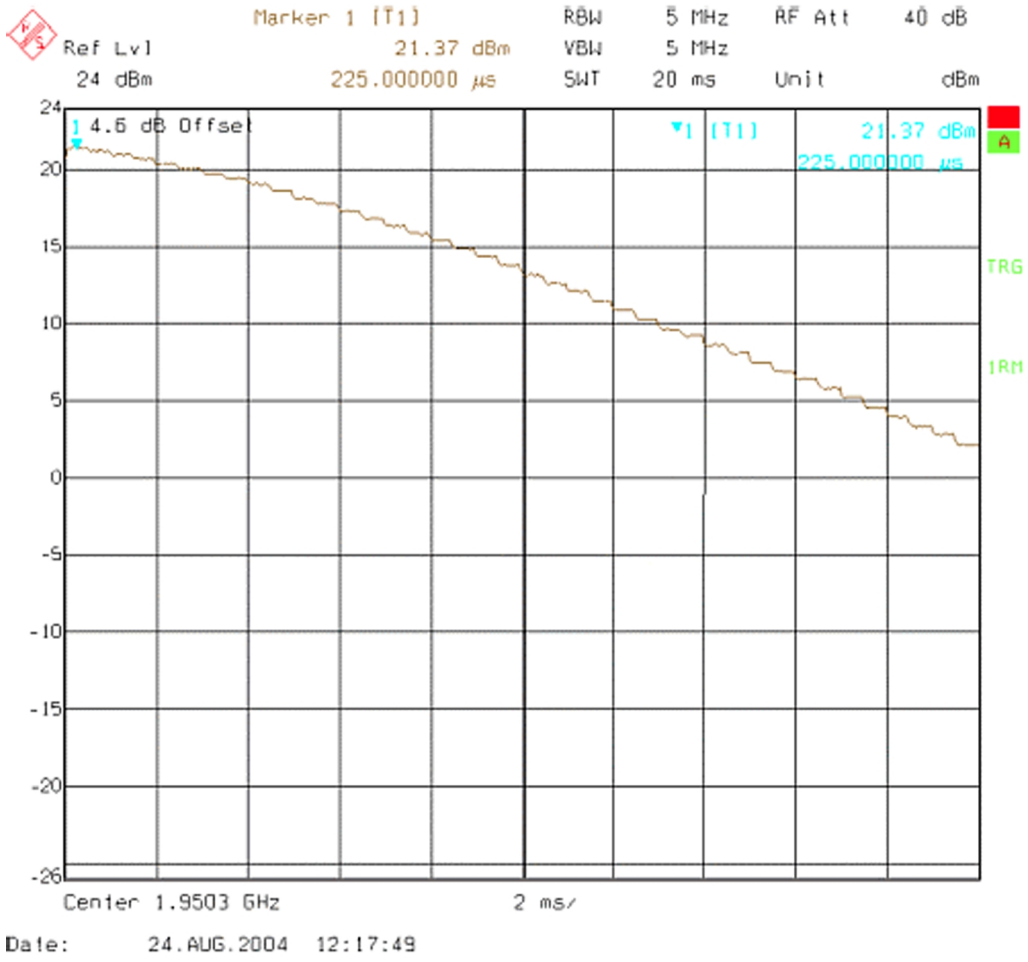


**Figure 66 High burst measurement**

13. In the *High Burst* pane, click **Calculate**.
14. Check that the calculated values are within the limits specified in the following table:

| | Min | Max |
|---|---|---|
| C0-high | -0.5 | 5 |
| C1-high | -50 | 50 |
| C2-high | 400 | 900 |
| C0-mid | -0.7 | 0.7 |
| C1-mid | 0 | 50 |
| C2-mid | 400 | 900 |
| C0-low | -4 | 4 |
| C1-low | -400 | 440 |
| C2-low | -10000 | 15000 |


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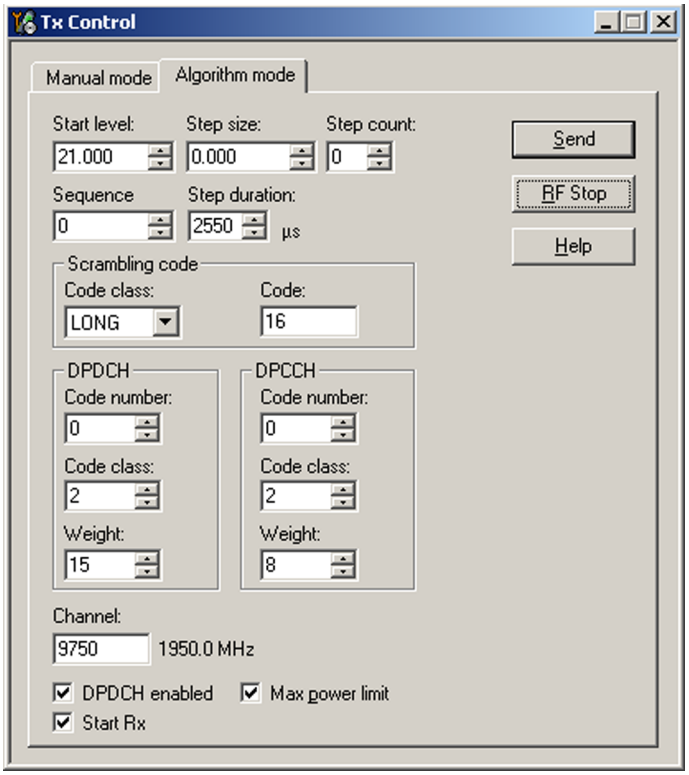
| | Min | Max |
|---|---|---|
| Det-k | 100 | 220 |
| Det-b | 0 | 150 |

15. To save the coefficients to the phone, click **Write**.
16. To close the *Tx AGC & Power Detector* window, click **Close**.
17. Choose **Testing→WCDMA→ Tx Control.**
18. Select the *Algorithm* mode tab.




19. Write the target power level 25 dBm to the *Start level* line and check the **Max power limit** check box (detector calibration check).
20. Setup the spectrum analyzer with the following settings:

| | |
|---|---|
| Center frequency: | **1950.3 MHz** |
| Span: | 0 Hz |
| Reference level offset: | Cable attenuations + adapter attenuation |
| Reference level: | **24 dBm or -20 dBm depending on the level measured** |
| Input attenuation: | Automatic |
| Resolution bandwidth: | 5 MHz |
| Video bandwidth: | 5 MHz |
| Sweep time: | 20 ms |
| Detector: | **RMS detector** |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| | |
|---|---|
| Average: | No |
| Trigger: | Free run |

21. Click **Send**.
22. Measure the WCDMA output power.

    It should be around 21 dBm.
23. Click **RF Stop** and uncheck the **Max power limit** check box.
24. Repeat steps **19** to **23** for levels +19, +7, 0, -20 and –40 dBm.

    The measured output power may not differ more than +-2 dB from the requested value at level +19 dBm and no more than +-4 dB on lower levels.

    Remember to stop the RF before sending new data.

## Alternative steps

- Measure the wide range levels normally and write down the levels that are possible to measure.
- Click **Finish**.
- Click **Options**.
- Change the first wide range DAC value to *573* and change the number of tuning steps to *21*.
- Change the spectrum analyzer reference level to *–20* dBm and adjust the input attenuator to the lowest value possible.
- In the *Wide Range* pane, click **Tune** and fill in the rest of values starting from the 19th level.

# *Tx band response calibration (WCDMA)*

## Context

The purpose of this tuning operation is to calibrate the WCDMA Tx performance. It defines the power detector and Tx frequency compensation values. However, before starting this tuning procedure, it is necessary to carry out Tx AGC & Power Detector Calibration tuning. This is because its results will be needed for this tuning operation.

- In the *Tuning Settings* pane, it is possible to edit the numbers of channels used in this tuning operation.
- If the **Calibrate Detector Response** check box is checked, only Tx response is calibrated. Zero is written to the power detector compensation values block in the permanent memory (PM) of the terminal.
- **Detector Calibration level** shows the power level used for calibrating the power detector in this tuning procedure.
- **Tx Calibration level** shows the power level used for calibrating tx frequency in this tuning procedure.
- In the *Measured Power Levels* pane, you can insert the dBm values read from the power meter.
- In the *Tuned Values* pane, the values that are stored in the permanent memory (PM) of the terminal in Current columns are shown.
- New values are added to *New* column when the **Calculate** button is clicked.
- The **Abort** button aborts the tuning operation without saving the tuned values.
- The **Read** button reads the tuned values in the PM of the terminal, and displays them in the *Tuned Values* pane in in the *Current* column.

## Steps

1. Start *Phoenix* service software.
2. Choose **File→Scan Product** .


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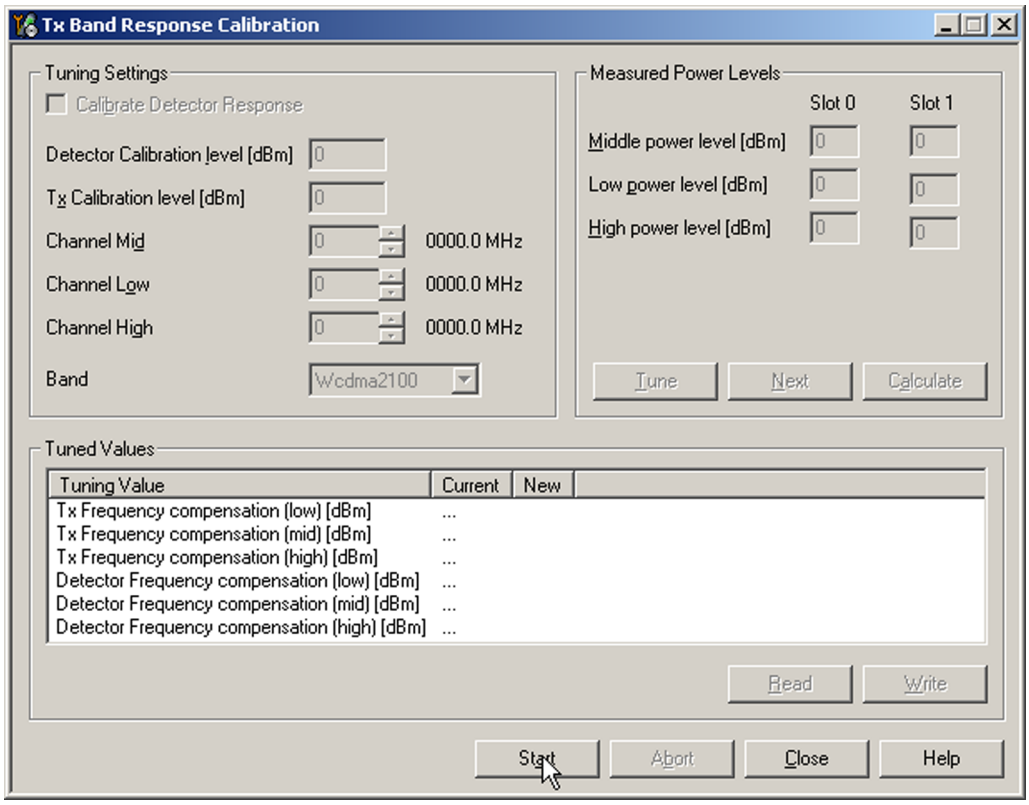
3. From the **Operating mode** drop-down menu, set mode to **Local**.
4. Choose **Tuning→WCDMA→Tx Band Response Calibration** .
5. Click **Start**.




The current values are shown in the *Tuned Values* pane.

6. Click **Tune**.
7. Connect the power meter to the terminal, and set it to **Channel Mid** frequency.
8. Read the values of slot 0 and slot 1 from the power meter and enter them to **Middle power level** fields in the **Measured Power Levels** pane.

   Slot 0 is used for detector calibration and slot 1 for Tx calibration.
9. Click **Next**.
10. Switch the power meter to **Channel Low** frequency.
11. Read the values from the power meter, and enter them to **Low power level** fields.
12. Switch the power meter to **Channel High** frequency.
13. Read the values from the power meter, and enter them to **High power level** fields.
14. Click **Next**.
15. Click **Calculate**.

    The tuned values are shown in the *Tuned Values* pane in the *New* column.
16. Check that the tuned values are within the limits presented in the following table. If they are OK, click **Yes**.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| | Min | Max |
|---|---|---|
| Tx Freq Comp (the first and last value) | -4 | +4 |

17. To save the tuned values to the terminal, click **Write**.
18. Close the *Tx Band Response Calibration* window.

### *Tx LO leakage (WCDMA)*

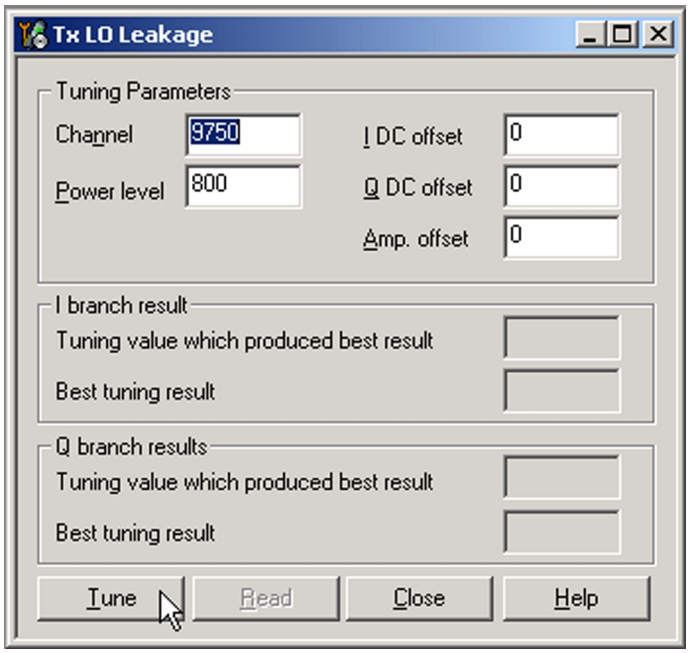
## Context

The purpose of Tx LO leakage tuning is to minimize the carrier leakage of the IQ-modulator which is caused by the DC offset voltages in the Tx IQ-signal lines and in the actual IQ modulator.

The tuning improves WCDMA Tx AGC dynamics at low power levels. A self-calibration routine selects the best combination for internal control words in order to produce minimum LO leakage.

## Steps

1. From the **Operating mode** drop-down menu, set mode to **Local**.
2. Choose **Tuning→WCDMA→ Tx LO Leakage** .
3. Click **Tune**.




4. To end the tuning, click **Close**.

# WLAN transmitter troubleshooting

## WLAN Tx tuning

## Steps

1. From the *Tuning* menu choose **WLAN TX tuning**.
2. Press **Start**.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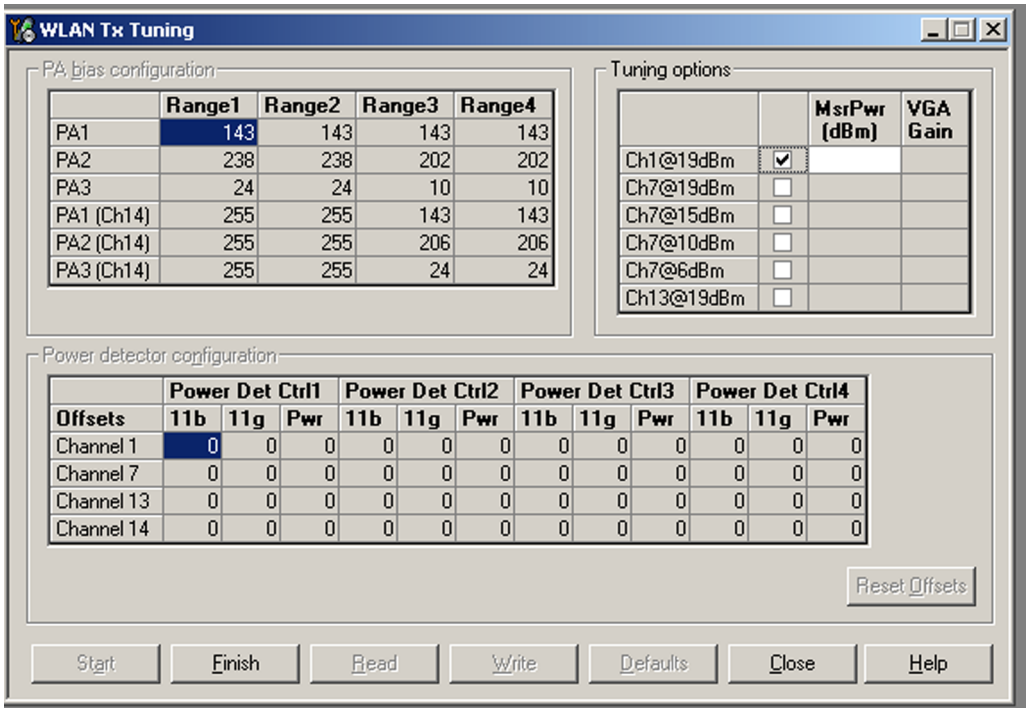
3. Tick the **Tuning options** Ch1@19dBm.




4. Measure power with power meter.
5. Place the power meter reading into Ch1@19dBm MsrPwr(dBm).
6. Repeat for all **Tuning options**.
7. Press **Finish**.

## WLAN Tx tests

### Steps

1. From *Testing* menu select **WLAN TX Tests**.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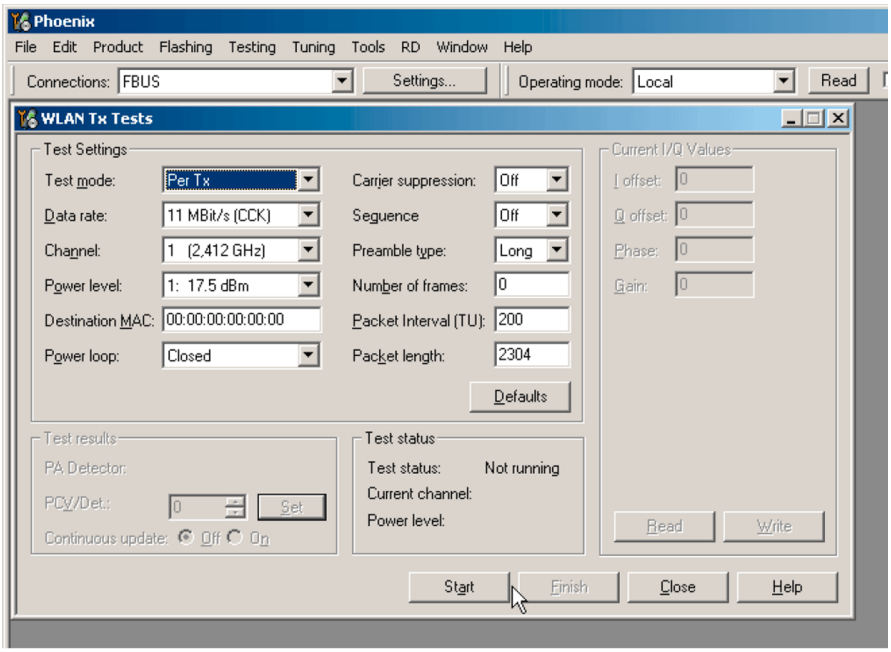
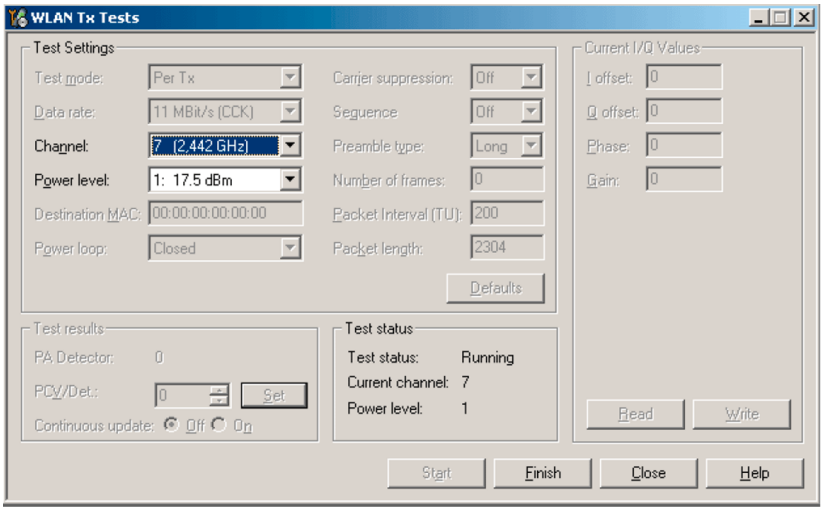
2. Make the selection as shown in the box below:




3. Press **Start**.
   Now you should see the following box:




4. Measure the ouput power via the WLAN/ BT RF connector with a power meter.
   For Power level 1: 17.5dBm, you shall see +16dBm (+/- 1dB).
5. Repeat steps 2 to 4 for the other power level.
   You shall see the following values:
   - Power output level 2 = 14dBm (+/- 1dB)
   - Power output level 3 = 9dBm(+/- 1dB)
   - Power output level 4 = 6dBm (+/- 1dB)

   Change to continuous mode if using the other power levels.
6. Now repeat the same exercise for Data Rate = 54Mbps.
   You shall see the following power levels: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- Power output level 1 = 13dBm (+/- 1dB)
- Power output level 2 = 13dBm (+/- 1dB)
- Power output level 3 = 8dBm (+/- 1dB)
- Power output level 4 = 5dBm (+/- 1dB)


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# 8 — Camera Module Troubleshooting


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# Introduction to camera module troubleshooting

## Background, tools and terminology

Faults or complaints in camera operation can be roughly categorised into three subgroups:

1 Camera is not functional at all; no image can be taken.

2 Images can be taken but there is nothing recognizable in them.

3 Images can be taken and they are recognizable but for some reason the quality of images is seriously degraded.

Image quality is very hard to measure quantitatively, and even comparative measurements are difficult (comparing two images) to do, if the difference is small. Especially if the user is not satisfied with his/her device's image quality, and tells, for example, that the images are not sharp, it is fairly difficult to accurately test the device and get an exact figure which would tell whether the device is functioning properly.

Often subjective evaluation has to be used for finding out if a certain property of the camera is acceptable or not. Some training or experience of a correctly operating reference device may be needed in order to detect what actually is wrong.

It is easy for the user to take bad images in bad conditions. Therefore the camera operation has to be checked always in constant conditions (lighting, temperature) or by using a second, known-to-be good device as reference.

When checking for possible errors in camera functionality, knowing what error is suspected significantly helps the testing by narrowing down the amount of test cases. The following types of image quality problems may be expected to appear:

- Dust (black spots)
- Lack of sharpness
- Bit errors

## Terms

| | |
|---|---|
| *Dynamic range* | Camera's ability to capture details in dark and bright areas of the scene simultaneously. |
| *Exposure time* | Camera modules use silicon sensor to collect light and for forming an image. The imaging process roughly corresponds to traditional film photography, in which exposure time means the time during which the film is exposed to light coming through optics. Increasing the time will allow for more light hitting the film and thus results in brighter image. The operation principle is exactly the same with silicon sensor, but the shutter functionality is handled electronically i.e. there is no mechanical moving parts like in film cameras. |
| *Flicker* | Phenomenon, which is caused by pulsating in scene lighting, typically appearing as wide horizontal stripes in an image. |
| *Noise* | Variation of response between pixels with same level of input illumination. |
| *Resolution* | Usually the amount of pixels in the camera sensor. In some occasions the term resolution is used for describing the sharpness of the images. |
| *Sensitivity* | Camera module's sensitivity to light. In equivalent illumination conditions, a less sensitive camera needs a longer exposure time to gather enough light in forming a good image. Analogous to ISO speed in photographic film. |


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| | |
|---|---|
| *Sharpness* | Good quality images are 'sharp' or 'crisp', meaning that image details are well visible in the picture. However, certain issues, such as non-idealities in optics, cause image blurring, making objects in picture to appear 'soft'. Each camera type typically has its own level of performance. |

## The effect of image taking conditions on image quality

There are some factors, which may cause poor image quality, if not taken into account by the end user when shooting images, and thus may result in complaints. The items listed are normal to camera operation and are not a reason for changing the camera module.

### Distance to target

Distance to target: the lens in the module is specified to operate satisfactorily from 40 cm to infinite distance of scene objects. In practice, the operation is such that close objects may be noticed to get more blurred when distance to them is shortened from 40 cm. Lack of sharpness will be first visible in full resolution (1600 x 1200) images. If observing just the viewfinder, even very close objects may seem to appear sharp. This is normal behaviour, do not change the camera module.

**Figure 67 Blurred image. Target too close.**

### The amount of light available

In dim conditions camera runs out of sensitivity. The exposure time is long (especially in the night mode) and the risk of getting shaken (= blurred) images increases. In addition, image noise level grows. The maximum exposure time in night mode increases, therefore, images need to be taken with extreme care and by supporting the phone when the amount of light reflected from the target is low. Because of the longer exposure time and larger gain value, noise level increases in low light conditions. Sometimes blurring may even occur in daytime, if the image is taken very carelessly. See the figure below for an example. This is normal; do not change the camera module.


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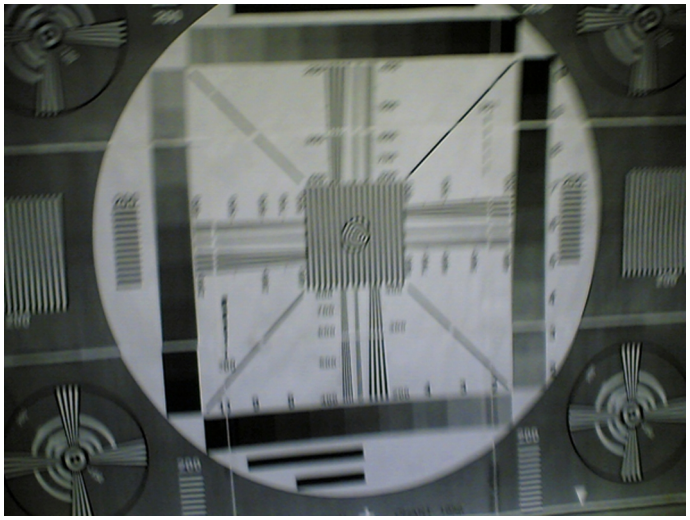

**Figure 68 Blurring caused by shaking hands**

## Movement in bright light

If an image is taken of moving objects or if the device is used in a moving vehicle, object 'skewing' or 'tilting' may occur. This phenomenon is fundamental to most CMOS camera types, and usually cannot be avoided. The movement of camera or object sometimes cause blurring indoors or in dim lighting conditions because of long exposure time. This is normal; do not change the camera module.

**Figure 69 Near objects get skewed when taking images from a moving vehicle**

## Temperature

High temperatures inside the mobile phone cause more noise to appear in images. For example, in >40 degrees (Celsius) ambient, the noise level may increase and it further grows if the conditions are dim. If the phone transmitter has been running at full power or the processor has been heavily loaded for a long time before image taking, the temperature inside the phone might be considerably higher than the temperature in the surrounding environment. This is normal to camera operation, do not change the camera module.


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**Figure 70 Noisy image taken in +70 degrees Celsius**

## Phone display

If the display contrast is set too dark, the image quality degrades: the images may be very dark depending on the setting. If the display contrast is set too bright, image contrast appears bad and "faint". This problem is solved by setting the display contrast correctly. This is normal behaviour; do not change the camera module.

## Basic rules of photography (especially shooting against light)

Because of dynamic range limitations, taking images against bright light might cause either saturated image or the actual target appear too dark. In practice, this means that when taking an image indoors and having, for example, a window behind the object, the result is usually poor. This is normal behaviour; do not change the camera module.

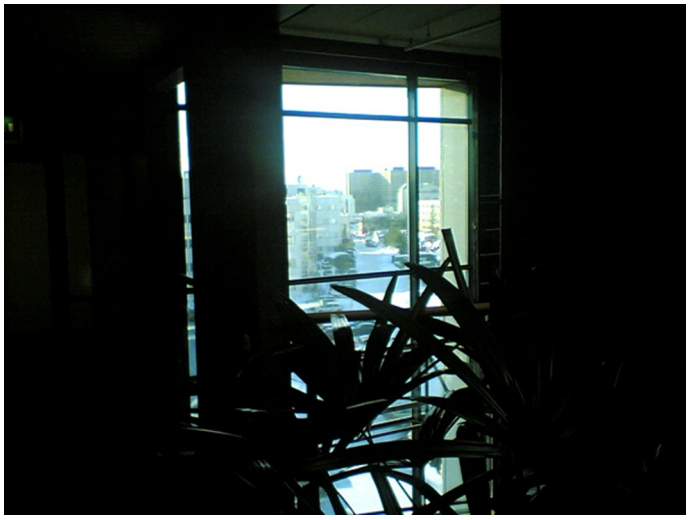

**Figure 71 Image taken against light; the actual object is dark**

## Flicker

In some occasions a bright fluorescent light may cause flicker in the viewfinder and captured image. This phenomenon may also be a result, if images are taken indoors under the mismatch of 50/60 Hz electricity network frequency. The electricity frequency used is automatically detected by the camera module. In some very few countries, both 50 and 60 Hz networks are present and thus probability for the phenomenon increases. Flickering occurs also under high artificial illumination level. This is normal behaviour; do not change the camera module.


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**Figure 72 Flicker in an image; uniform object illuminated by strong fluorescent light**

## Bright light outside of image view

Especially the sun can cause clearly visible lens glare phenomenon and poor contrast in images. This happens because of undesired reflections inside the camera optics. Generally this kind of reflections are common in all optical systems. This is normal behaviour; do not change the camera module.

**Figure 73 A lens reflection effect caused by sunshine**


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## Examples of good quality images

**Figure 74 Good image taken indoors**

**Figure 75 Good image taken outdoors**

# Image quality analysis

## Testing for dust in camera module

### Symptoms and diagnosis

For detecting dust problems, take an image of a uniform white surface and analyse it in full resolution. A good quality PC CRT monitor is preferred for analysis (avoid using LCD). Search carefully because finding these defects is not always easy. Figure "Effects of dust on optical path" is an example of an image having easily detectable dust problems.

When taking a white image, use uniformly lightened white paper or white wall. Another option is to use uniform light but in this case make sure that the camera image is not flickering when taking the test image. In case flickering occurs, try to reduce the illumination level. Use JPEG image format for analysing, and set the image quality parameter to ‘High Quality’.


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Black spots in an image are caused by dirt particles trapped inside the optical system. Clearly visible and sharp edged black dots in an image are typically dust particles on the image sensor. These spots are searched for in the manufacturing phase, but it is possible that the camera body cavity contains a particle, which may move onto the image sensor active surface, for example, when the phone is dropped. Therefore it is also possible that the problem will disappear before the phone is brought to service. The camera should be replaced if the problem is present when the service technician analyses the phone.

If dust particles are lying on the infrared filter surface on either side, they are hard to locate because they are out of focus, and appear in the image as large, grayish and fading-edge 'blobs'. Sometimes they are invisible to the eye, and the user probably does not notice them at all. However, it is possible that a larger particle disturbs the user, causing need for service.

**Figure 76 Effects of dust on optical path**

If large dust particles get trapped on top of the lens surface in the cavity between the camera window and the lens, they will cause image blurring and poor contrast. If dust stays on the camera module surface, camera cussion, camera bezel or window at assembling, dust may sneak into the optical system as the optical zoom or Auto focus lens moves back and forth. The camera cussion and bezel between the window and the lens unit or camera module should prevent any particles from getting into the cavity after the manufacturing phase.

If dust particles are found on the sensor, this is classified as a manufacturing error of the module, and the camera should be replaced. Any particles inside the cavity between the protection window and the lens have most probably been trapped there in the assembly phase at a Nokia factory. Unauthorized disassembling of the product can also be the root of the problem. However, in most cases it should be possible to remove the particle(s) by using clean compressed air. Never wipe the lens surface before trying compressed air; the possibility of damaging the lens is substantial. Always check the image sharpness after removing dust.

## Testing camera image sharpness

### Symptoms and diagnosis

If pictures taken with a device are claimed to be blurry, there are six possible sources for the problem:

1 The protection window is fingerprinted, soiled, dirty, visibly scratched or broken.

2 The photographed object is too close – the camera lens operates with distances from 60 cm to infinity – or incorrect mode is selected using macro switch. This is no cause to replace camera module.

3 User has tried to take pictures in too dark conditions, and images are blurred due to handshake or movement. This is no cause to replace camera module.

4 There is dirt between the protection window and camera lens.


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5 The protection window is defective. This can be either a manufacturing failure or caused by the user. The window should be changed.

6 The camera lens is misfocused because of a manufacturing error.

A quantitative analysis of sharpness is very difficult to conduct in any other environment than optics laboratory. Therefore, subjective analysis should be used.

If no visible defects (items 1-4) are found, a couple of test images should be taken. Generally, a well-illuminated typical indoor scene can be used as a target. The main considerations are:

- The protection window has to be clean.
- The amount of light (300 – 600 lux (bright office lighting)) is sufficient.
- The scene should contain, for example, small objects for checking sharpness. Their distance should be 1 – 2 meters.
- If possible, compare the image to another image of the same scene, taken with a different device. Note that the reference device has to be a similar Nokia phone.

## Steps

1. Take several images of small objects in the distance of 1-2 metres.
2. Analyse the images on a PC screen at 100% scaling with the reference images.

   Pay attention to the computer display settings: at least 65000 colors (16-bit) have to be used. 256 (8-bit) color setting is not sufficient, and true color (24 bit, 16 million colors) or 32 bit (full color) setting is recommended.

## Next actions

If there appears to be a clearly noticeable difference between the reference image and the test images, the module might have a misfocused lens -> change the module.

Re-check the resolution after changing the camera module.

If the changed module produces the same result, the fault is probably in the camera window. Check the window by looking carefully through it when replacing the module.

### Dirty camera lens protection window

The following series of images demonstrates the effects of fingerprints on the camera protection window.

It should be noted that the effects of any dirt in images can vary much. It may be difficult to judge whether the window has been dirty or if something else is wrong. Therefore, the cleanness of the protection window should always be checked and the window should be wiped clean with a suitable cloth.

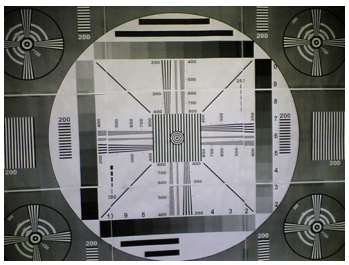

**Figure 77 Image taken with clean protection window**

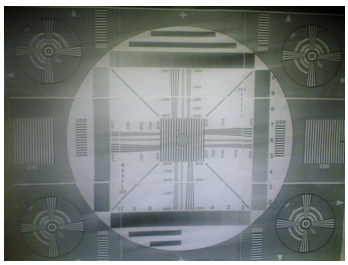

**Figure 78 Image taken with greasy protection window**

### Image bit errors

Bit errors are image defects caused by data transmission errors between the camera module and the phone baseband and/or errors inside the module.


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Usually bit errors can be easily detected in images, and they are best visible in full resolution images. A good practice is to use a uniform white test target when analysing these errors. The errors are clearly visible, colourful sharp dots or lines in camera images. See the following figure.

**Figure 79 Bit errors caused by JPEG compression**

One type of bit error is a lack of bit depth. In this case, the image is almost totally black under normal conditions, and only senses something in very highly illuminated environments. Typically this is a contact problem between the camera module and the phone main PWB. You should check the camera assembly and connector contacts.

If the fault is in the camera module, bit errors are typically visible only when using some specific image resolution. For example, in case of a viewfinder fault, the error might exist but is not visible in a full size image.

> **Note:** At the most 5 clusters of black dots or blemish are not considered errors, and no reason to replace camera module


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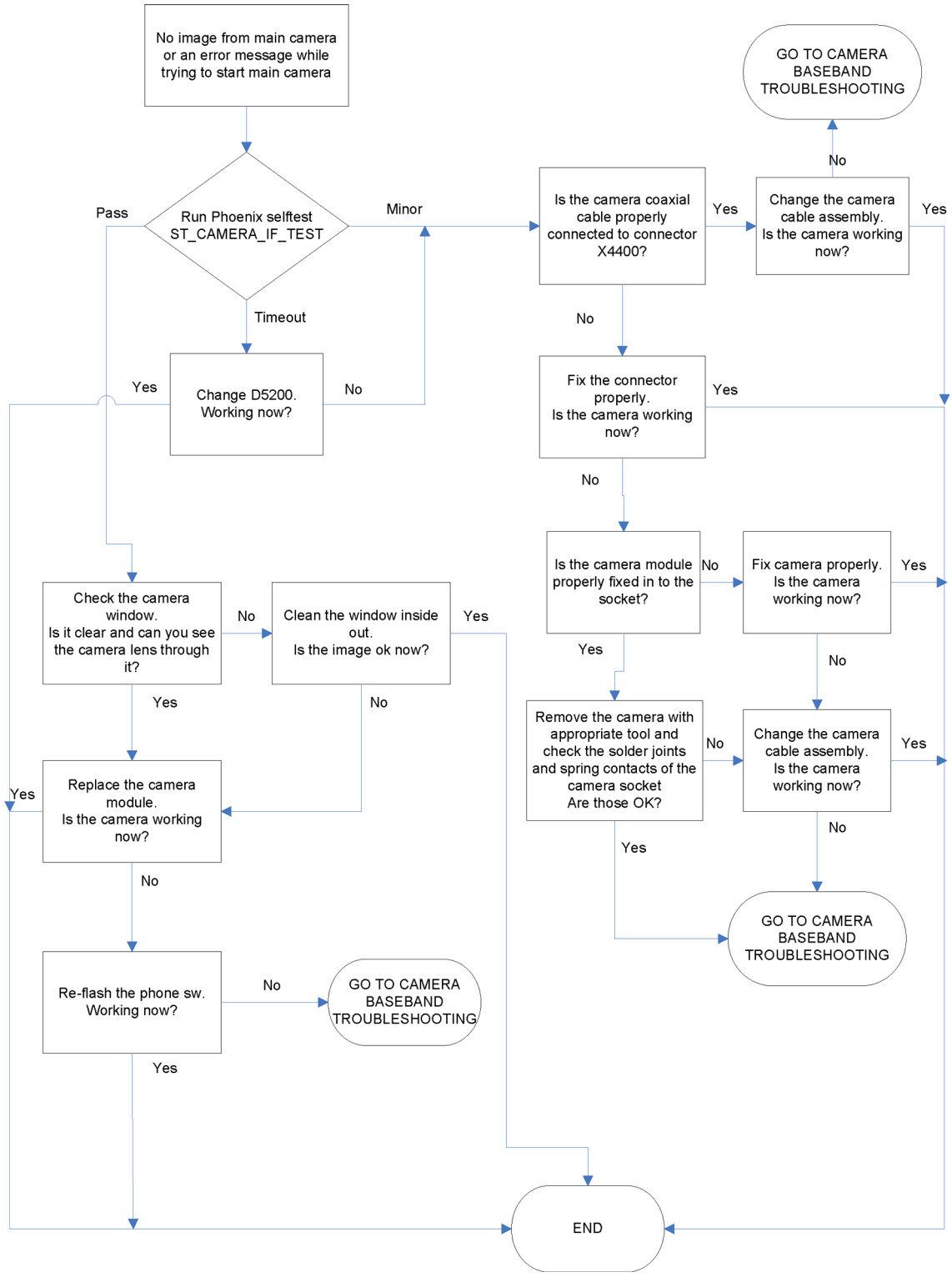
# Camera troubleshooting flowcharts

## Main camera troubleshooting

### Troubleshooting flow





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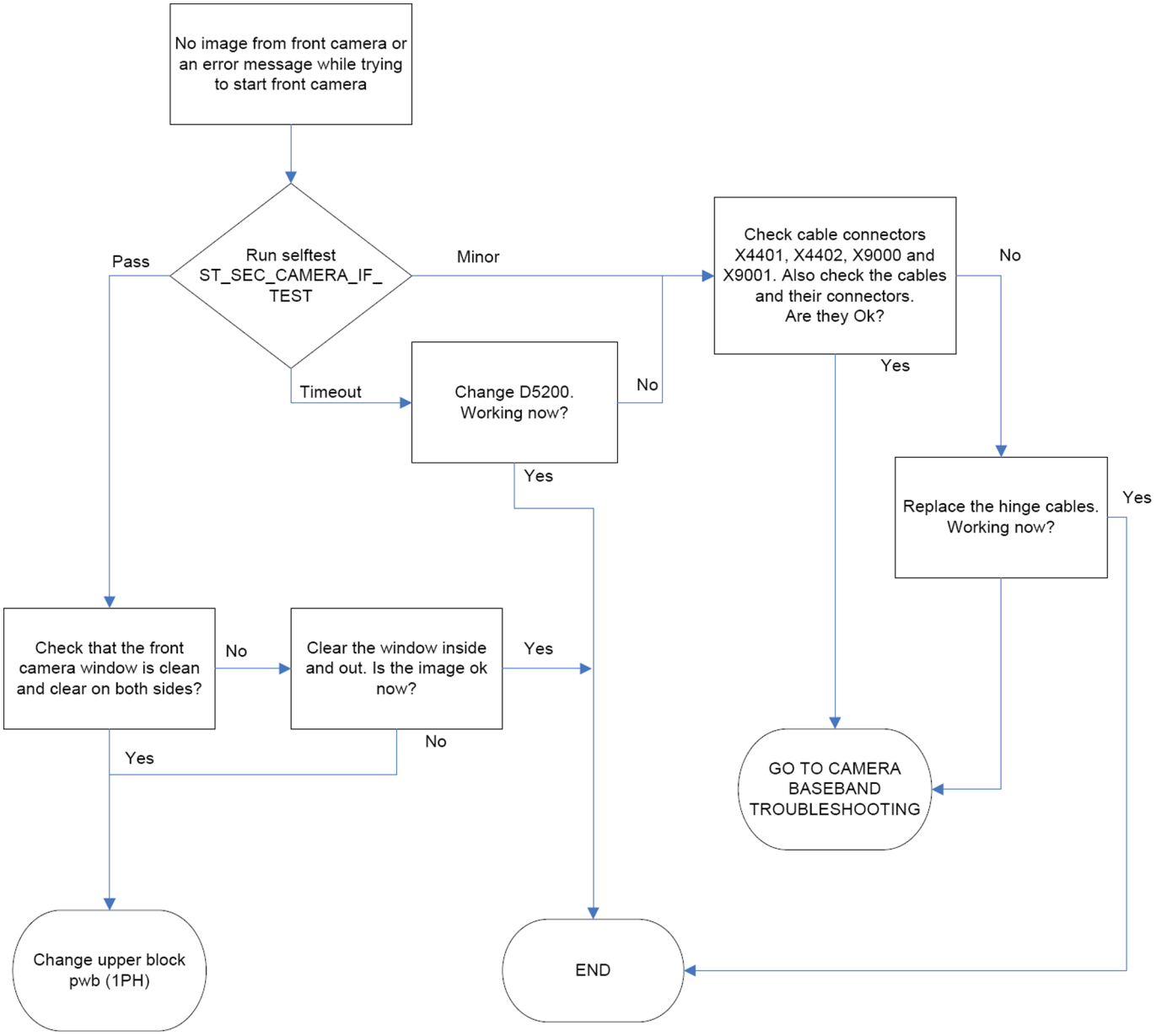
## Secondary camera troubleshooting

### Troubleshooting flow





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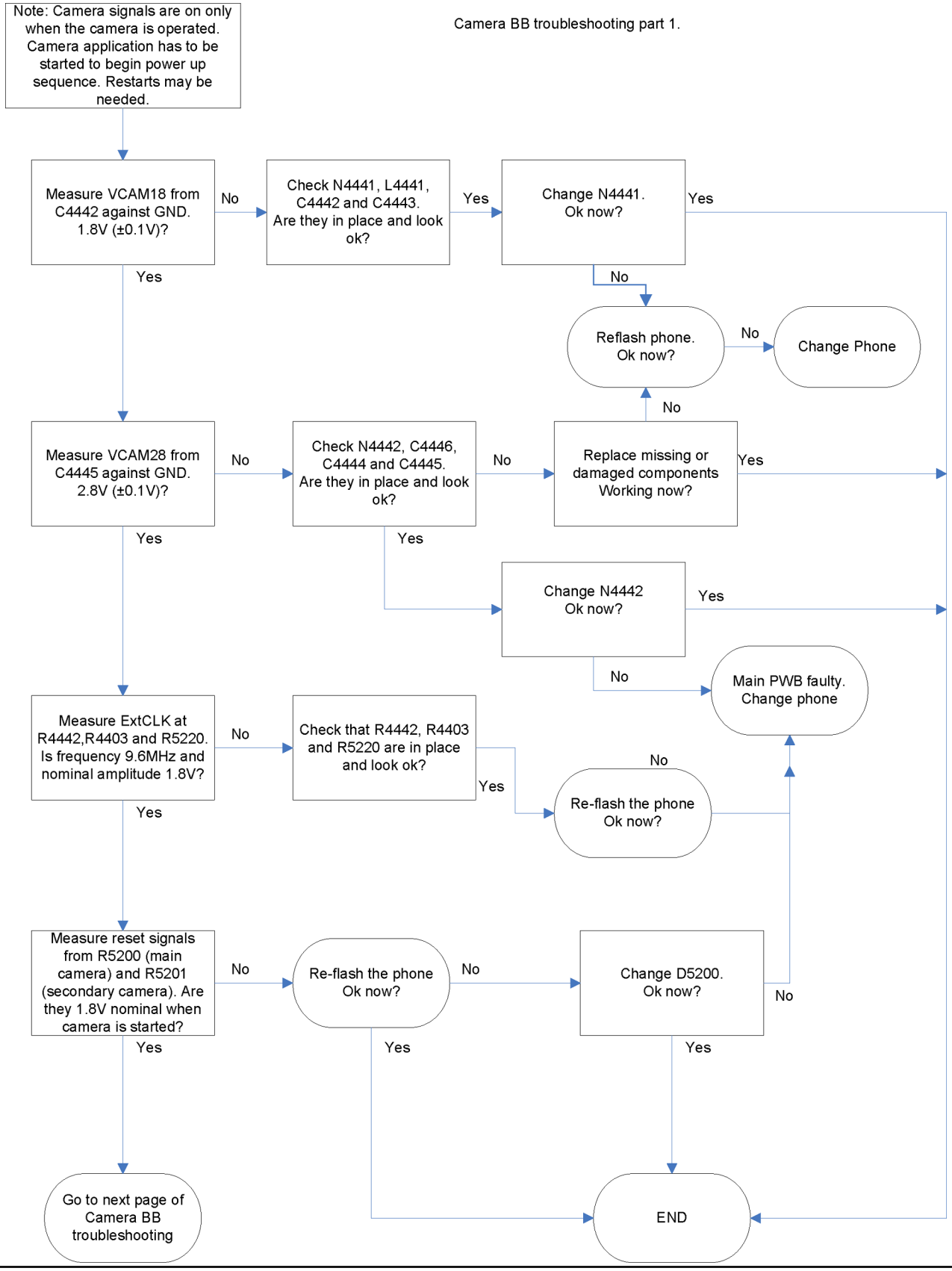
## Camera bb troubleshooting

# Troubleshooting flow





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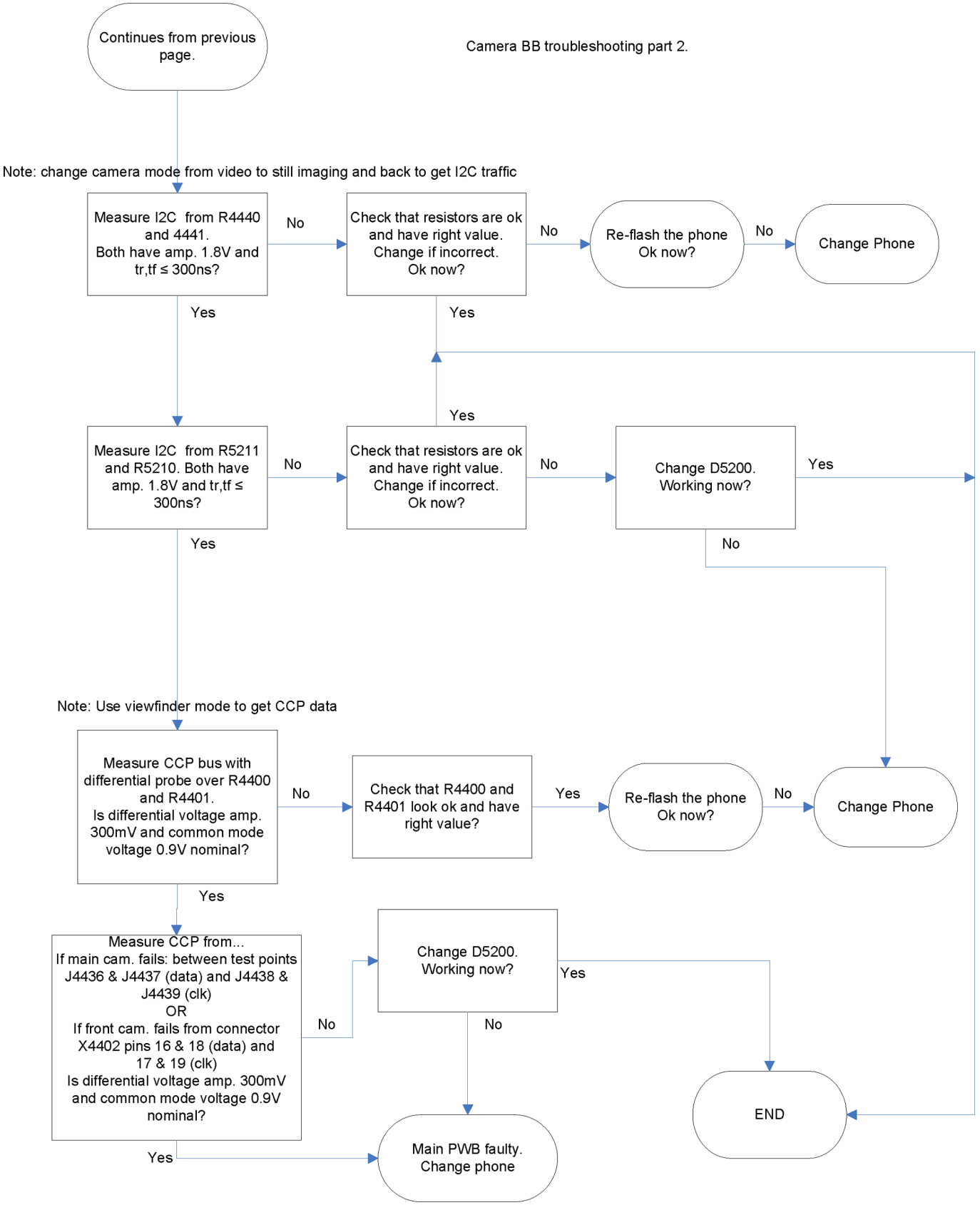



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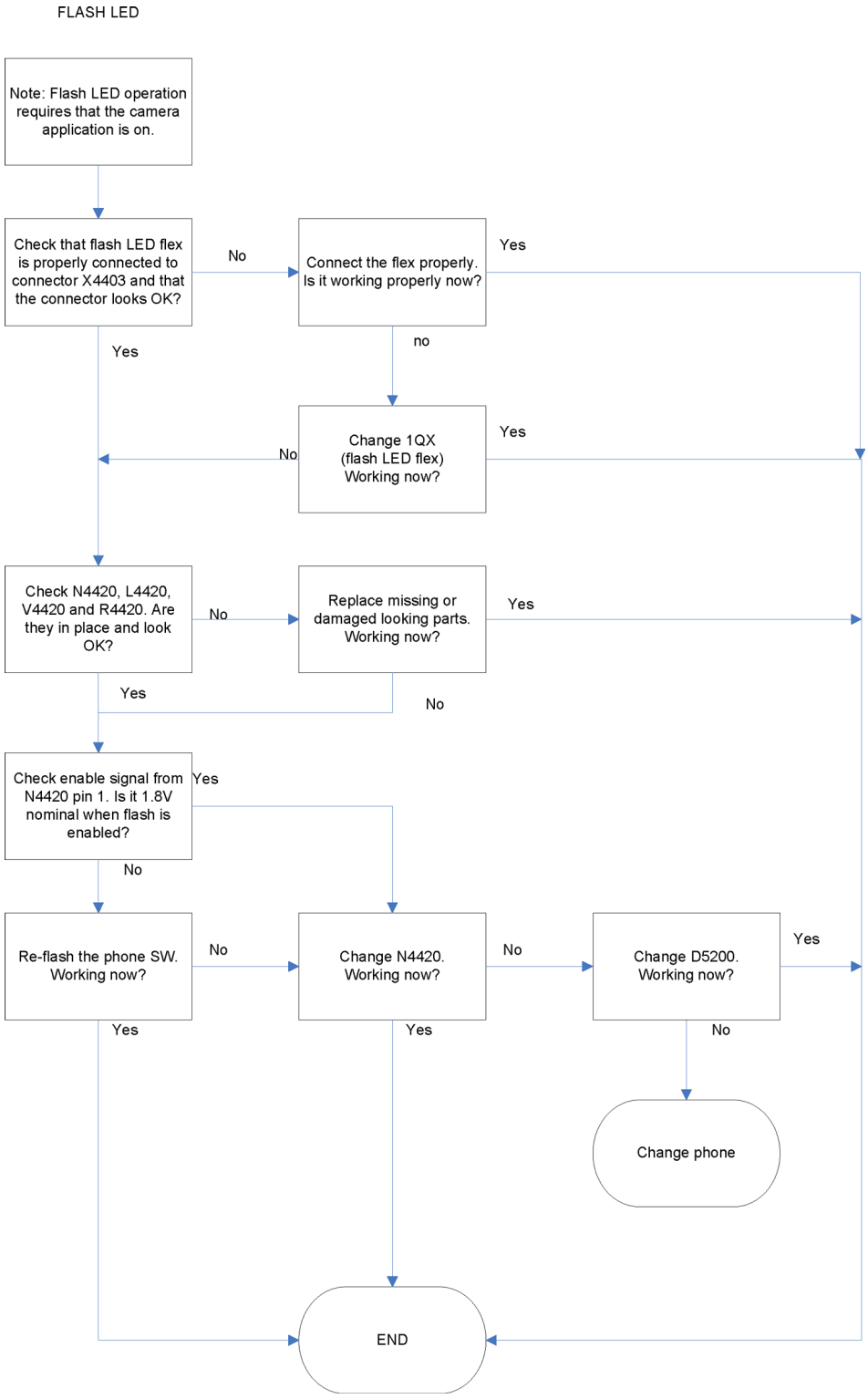
# Flash LED troubleshooting flowcharts

## Flash LED troubleshooting

### Troubleshooting flow





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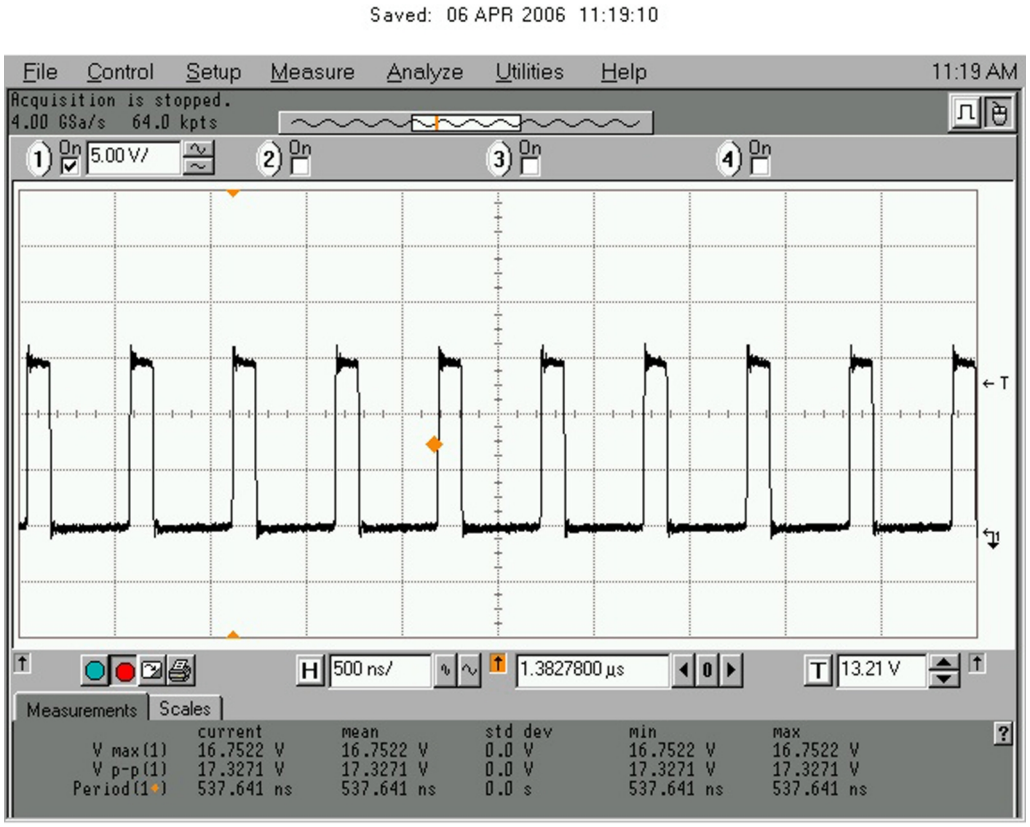


**Figure 80 L4420 LED flash SMPS coil**

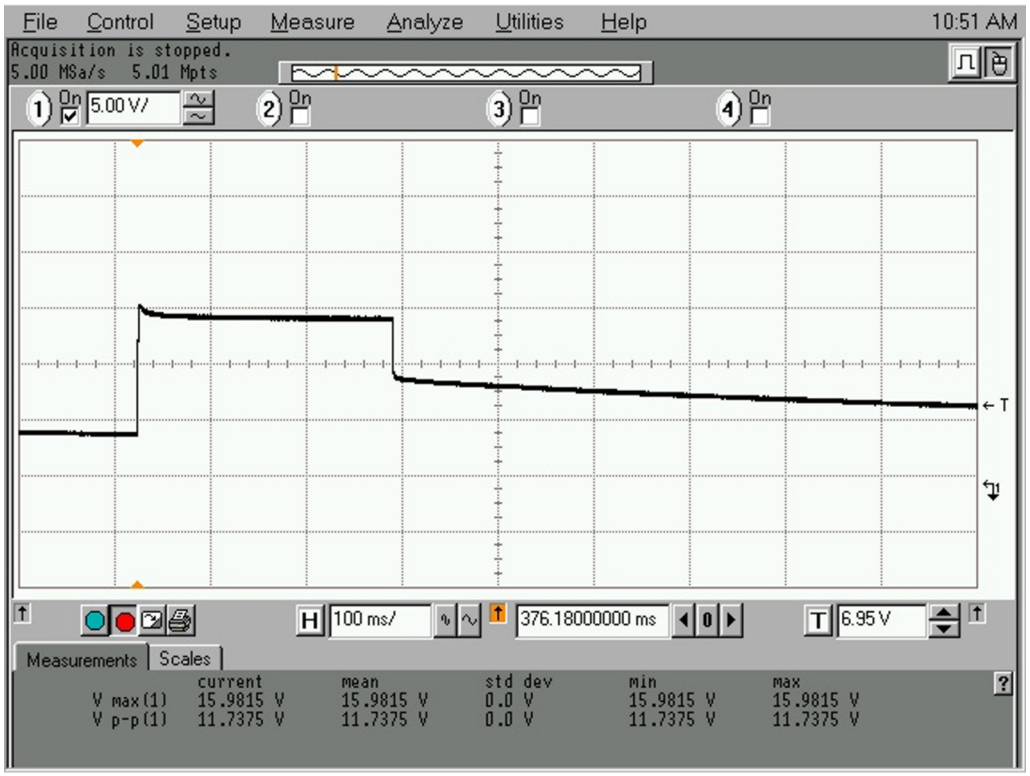


**Figure 81 R4424-2 LED flash voltage**


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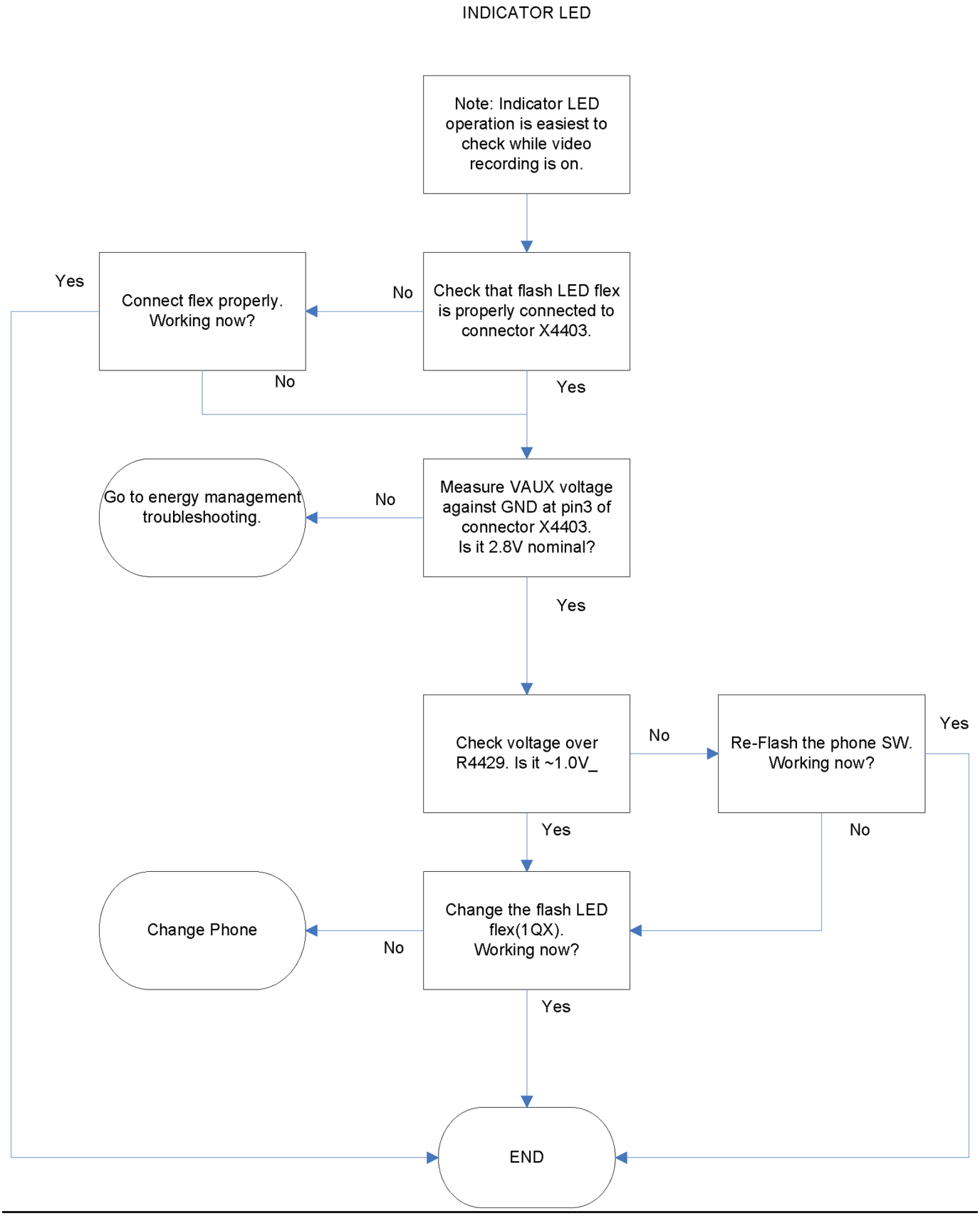
## Indicator LED troubleshooting

### Troubleshooting flow





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# 9 — TV troubleshooting


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## Service instructions

### Service instructions for DVB-H repairs

**Note:** Please see service concept from the Service tools and service concept (page ) chapter.

## DVB-H setup and self test

### Setup for DVB-H Self test

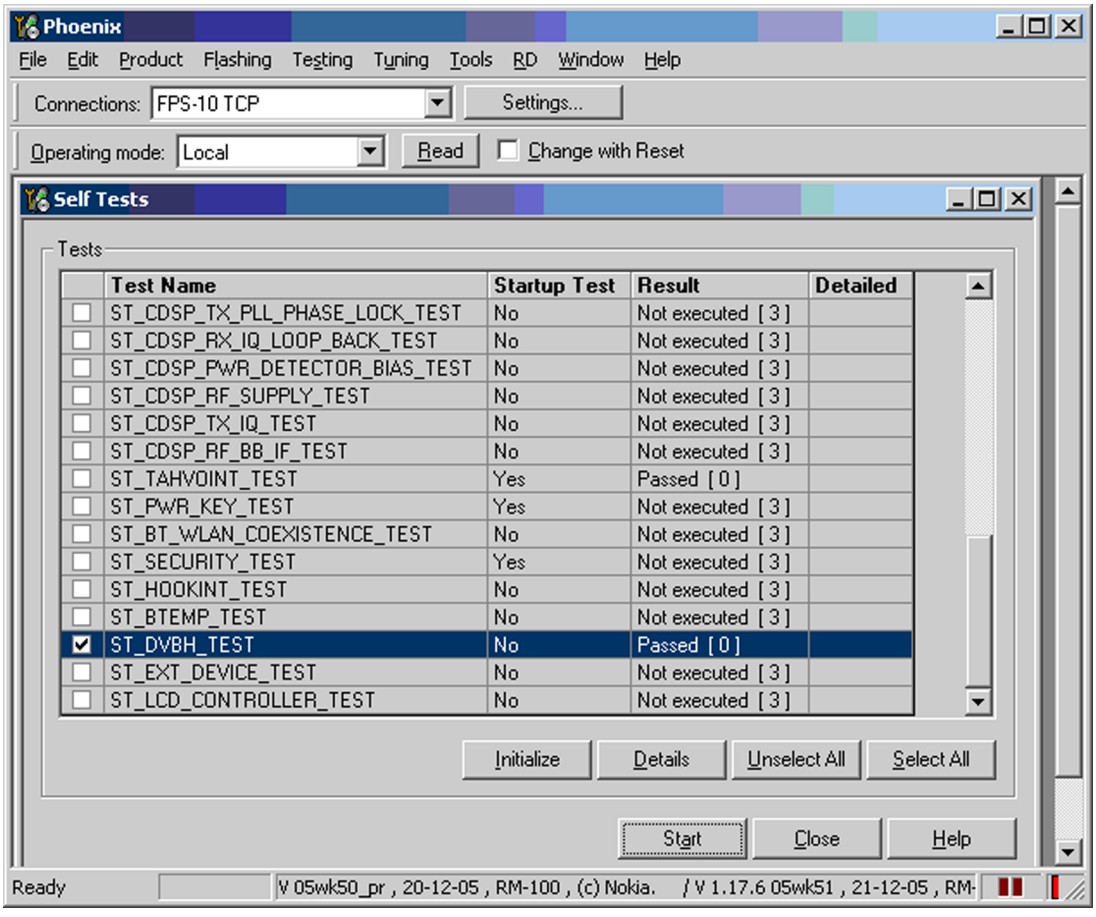
#### Steps

1. Connect the phone to setup with product specific adapter FS-17. SW update is needed if terminal SW is not the latest version.

### DVB-H Self test

#### Steps

1. From the **File** choose **Scan Product** .
2. Set operation mode to **Local**.
3. From **Testing** menu select **Self Test**.
4. Select **ST_DVB-H_TEST box** ( see figure below).
5. Press **Start**. The result can be seen from **Result** column.





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6. Follow the **DVB-H troubleshooting flowchart**.

**Table 16 Pass/Fail Failure codes**

| Result | Description | Action |
|---|---|---|
| 0x1 | $I^2C$ Connection to RF failed | Swap upper PWB. |
| 0x2 | $I^2C$ Connection to EEPROM failed | Swap upper PWB. |
| 0x3 | $I^2C$ Connection to antenna DAC failed | Swap upper PWB. |
| 0xFD | No connection to DVB-H Module | Replace hinge cables. |
| 0xF2 | Another test is ongoing | Restart phone and run the self test again. |

## DVB-H RX testing

### Test setup – Option 1 with RF coupler SA-100

### Steps

1. Measure RF input level with CW signal. Connect the phone to service concept, consisting of CU-4, SS-62, FS-17 and SA-100, as shown below (more details in Service tools and concepts (page ).
2. CW signal from Signal Generator is fed to GSM connector of the SA-100.
3. Start *Phoenix* and set **Operation mode** to **Local**.

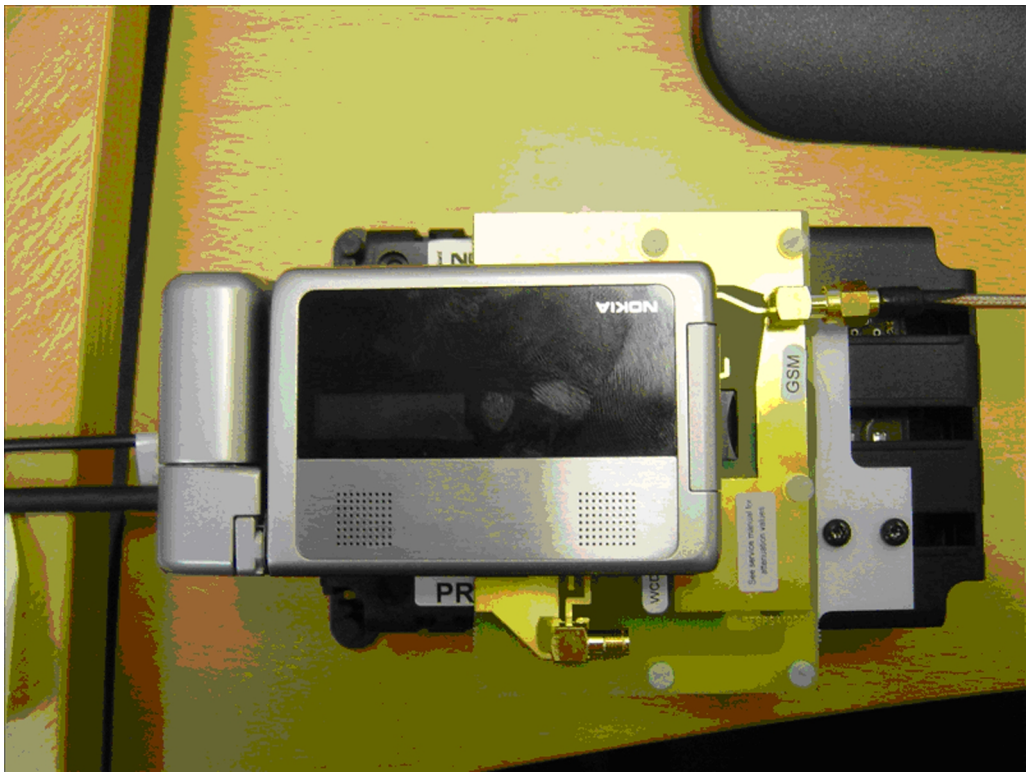


**Figure 82 RM-100 DVB-H RXtest set-up Option 1 – RF coupler**


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4. Run **DVB-H test** in Phoenix (see picture below).

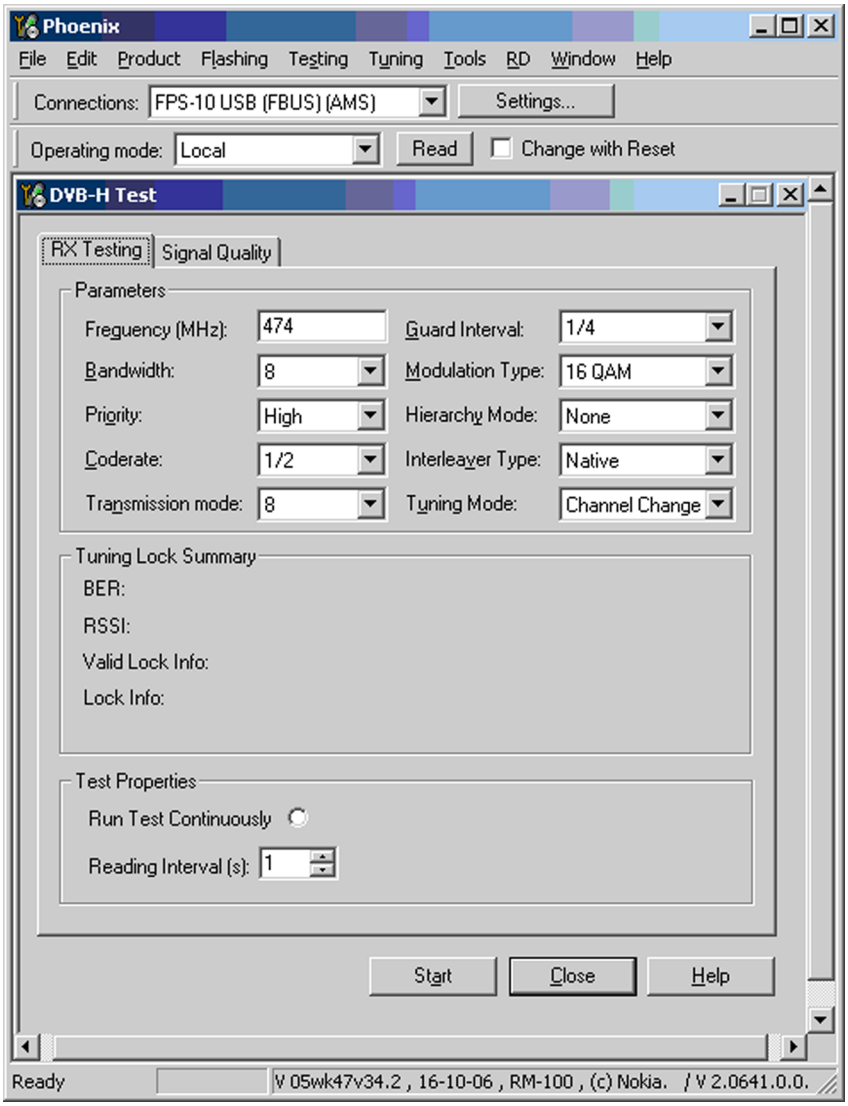


**Figure 83 Phoenix DVB-H testing window**

**Note:** The parameter needed to set in Phoenix DVB-H Test UI is Frequency.

Frequency value in parameters field DVB-H Test UI must always have 1MHz offset corresponding to CW (Continuous Wave) from Signal Generator e.g. when CW is set to 475MHz, type 474MHz in the field.

Other values need not to be changed i.e. default values can be used. See table of Pass and Failure codes.

## Verifying the DVB-H functionality with RX test

### Steps

1. Connect the signal generator RF output to the SA-100 GSM input.
2. Set the frequency in the signal generator to 475 MHz.
3. Set the output level (amplitude) of the signal generator to -30 dBm.
4. Set the frequency in the RX Testing field in Phoenix to 474 MHz (test window in the following figure) and mark **Run Test Continously** to get always actual RSSI value.


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5. Press the start button (see picture below).
6. Monitor the RSSI value in the Tuning Lock Summary field (see figure).
7. CW test result -> **RSSI reading** -> The RSSI value should be -69 dBm (±3 dBm).

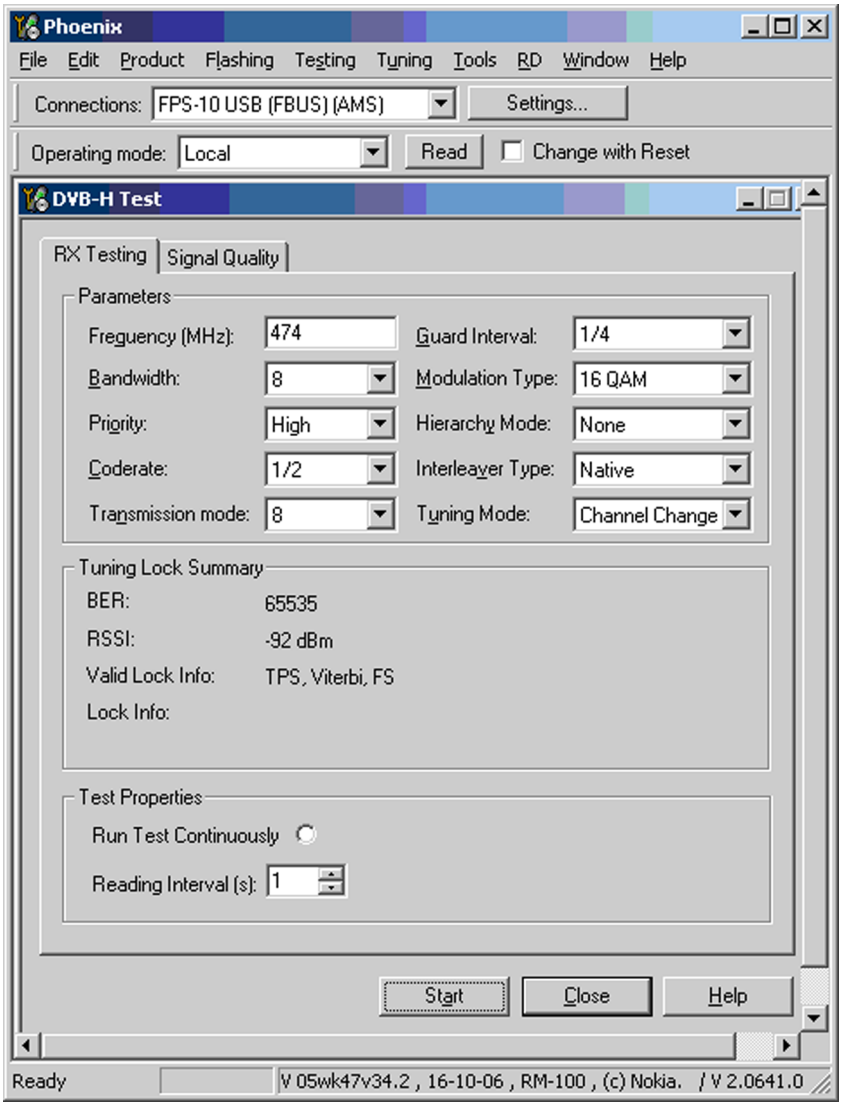


**Figure 84 Phoenix DVB-H testing window**

**Note:** CW test result -> RSSI reading ("Signal Quality" feature is not needed).

8. Run DVB-H RX Test also with frequencies 610 MHz and 746 MHz according to following table.

**Table 17 Setup and target test values (test option 1)**

| Frequency | Signal level | RSSI value | Tolerance |
|---|---|---|---|
| 474 | -30 dBm | -69 dBm | +/-3 dBm |
| 610 | -30 dBm | -56 dBm | +/-3 dBm |
| 746 | -30 dBm | -42 dBm | +/-3 dBm |

**Note:** Frequency in the table is typed in DVB-H Test/Frequency field. Set signal generator frequency always 1 MHz higher.


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## Test setup - Option 2 with Rohde & Schwarz Shielding box

### Steps

1. Connect the phone to shielded box CMU-Z11 consisting antenna coupler CMU-Z10 and USB feed trough CMU-Z13 as shown in the following figure . Location in the grid is C1. (More details in Service tools and service concepts (page ).
2. CW signal from Signal Generator is fed to Rohde & Schwarz Shieding box CMU-Z11 (including antenna coupler CMU-Z10).

**Figure 85 DVB-H test setup Option 2 – Shielding box**

3. Procedure for Measuring RF input level with CW signal is same as with **Test set up – Option 1, RF coupler SA-100**, but Setup and values corresponding to following table have to be used.

**Table 18 Setup and target test values (test option 2)**

| Frequency | Signal level | RSSI value | Tolerance |
|---|---|---|---|
| 474 | -30dBm | -63dBm | +/- 3 dBm |
| 610 | -30dBm | -60dBm | +/- 3 dBm |
| 746 | -30dBm | -51dBm | +/- 3 dBm |


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## DVB-H RF test measurement

### Galvanic DVB-H RF test measurement

**Note:** If the RSSI value is to be checked also from the RF connector, the procedure is as described in the step list above except that the RSSI value is more accurate i.e. with signal level -40dBm the value measured should be -40 dBm (±3dBm).

### Steps

1. Disassemble the phone.
2. Place disassemble phone to module jig MJ-75 and connect "RF probe" to DVB-H antenna connector through the dedicated hole in MJ-75. (see figure).

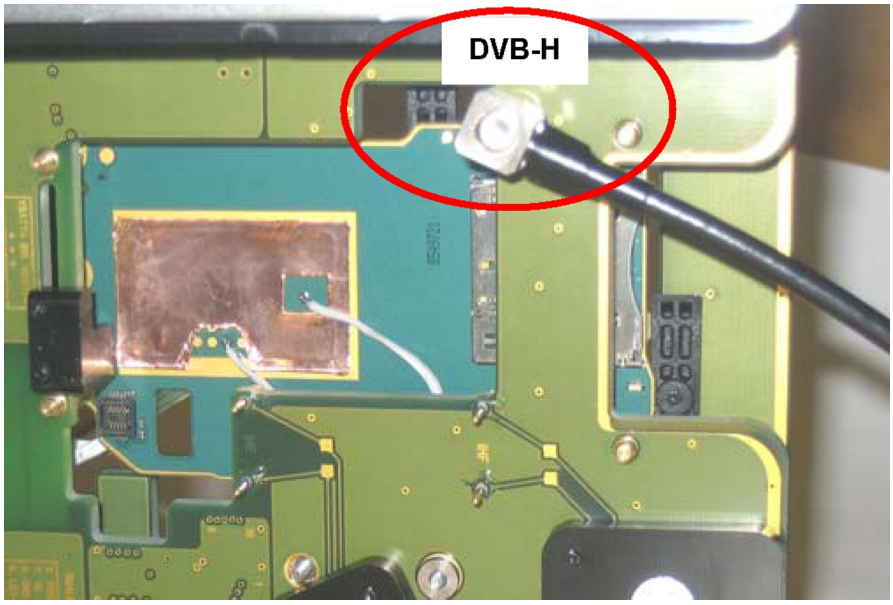


**Figure 86 RF probe connected to DVB-H antenna connector**

3. Proceed the steps 2-8 according to chapter **DVB-H RX testing - Verifying the DVB-H functionality with RX test**.

## DVB-H Tuning

### DVB-H Tuning

### DVB-H Tuning

DVB-H tuning is required when DVB-H PWB ASSY or any of the DVB-H antenna tuning components (L9400, V9400, V9401, R9400, R9401, C9400, C9402, C9410) has been replaced.

All "DVB-H PWB ASSY" spare parts will be supplied as version HWID 1500 (1PH-15a). HW version is printed on PWB (see red circle in figure).


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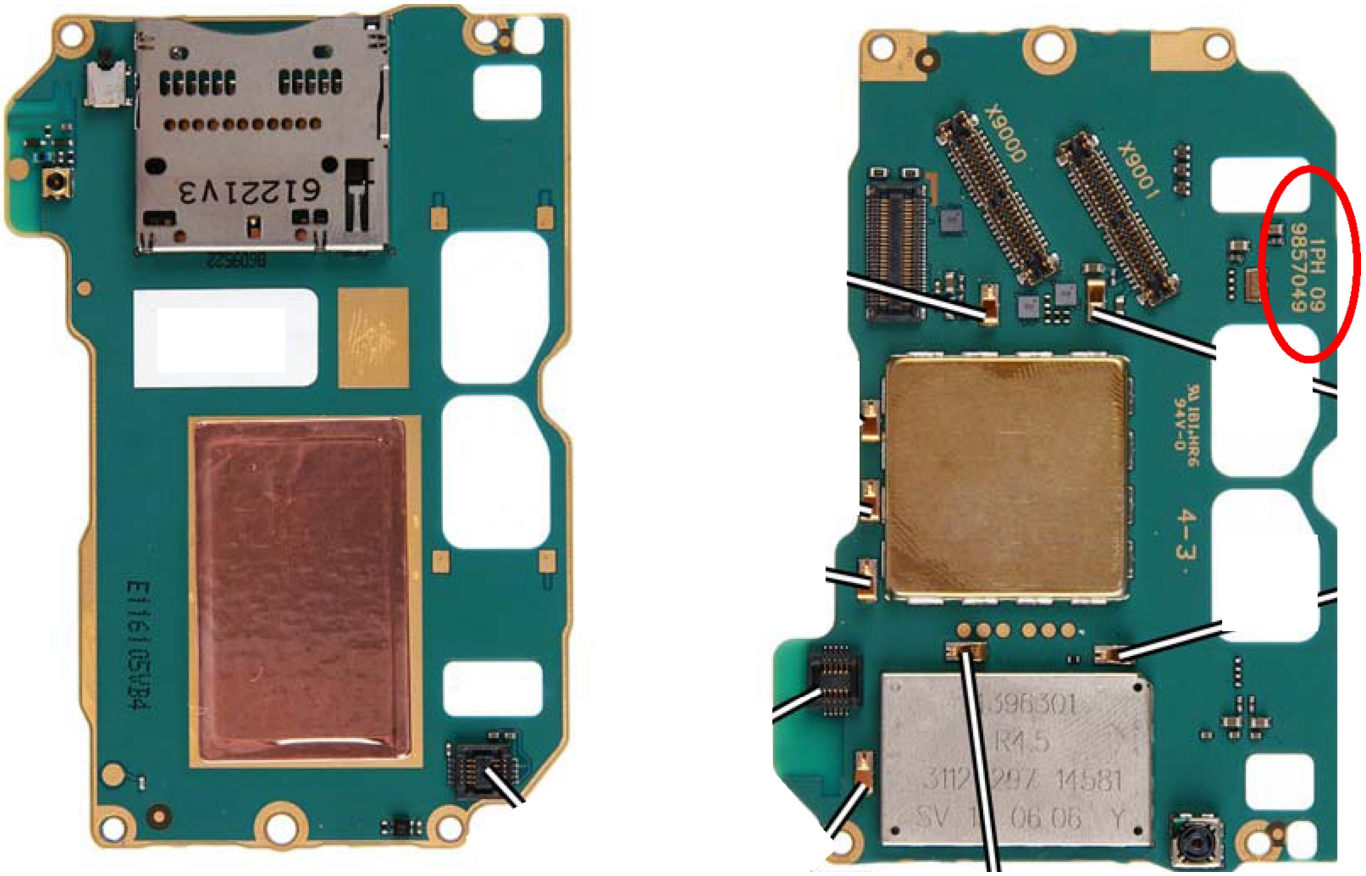


**Figure 87 DVB-H PWB ASSY both sides**

## Handling instructions

DVB-H tuning is allowed only in L3/L4 service. DVB-H tuning is required to perform in service with following combinations (if DVB-H PWB ASSY or any of the DVB-H antenna tuning components has been replaced):

| Combination | Phone HW version | HW version shown in Phoenix (read from Phoenix/ Product/Phone Information) | DVB-H tuning ((if DVB-H PWB ASSY or any of the DVB-H antenna tuning components has been replaced): |
|---|---|---|---|
| #1 | Bottom PWB (1NT_14a) + Top DVB-H PWB ASSY (1PH_14a) | HWID 1410 | NO - DVB-H tuning |
| #2 | Bottom PWB (1NT_15a) + Top DVB-H PWB ASSY (1PH_15a) | HWID 1500 | YES - DVB-H tuning required |
| #3 | Bottom PWB (1NT_14a) + Top DVB-H PWB ASSY (1PH_15a) | HWID 1410 | YES - DVB-H tuning required |


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**Note:** Combination #3 occurs only in service, when TOP DVB-H PWB ASSY has been replaced.

To identify terminal with combination #3, the only way is to disassemble the phone and read version number from TOP DVB-H PWB ASSY (see red circle in DVB-H PWB ASSY both sides-picture). Phoenix **Phone Information** tells only the HW version of the engine module.

## Applicable shielding box and antenna coupler for tuning

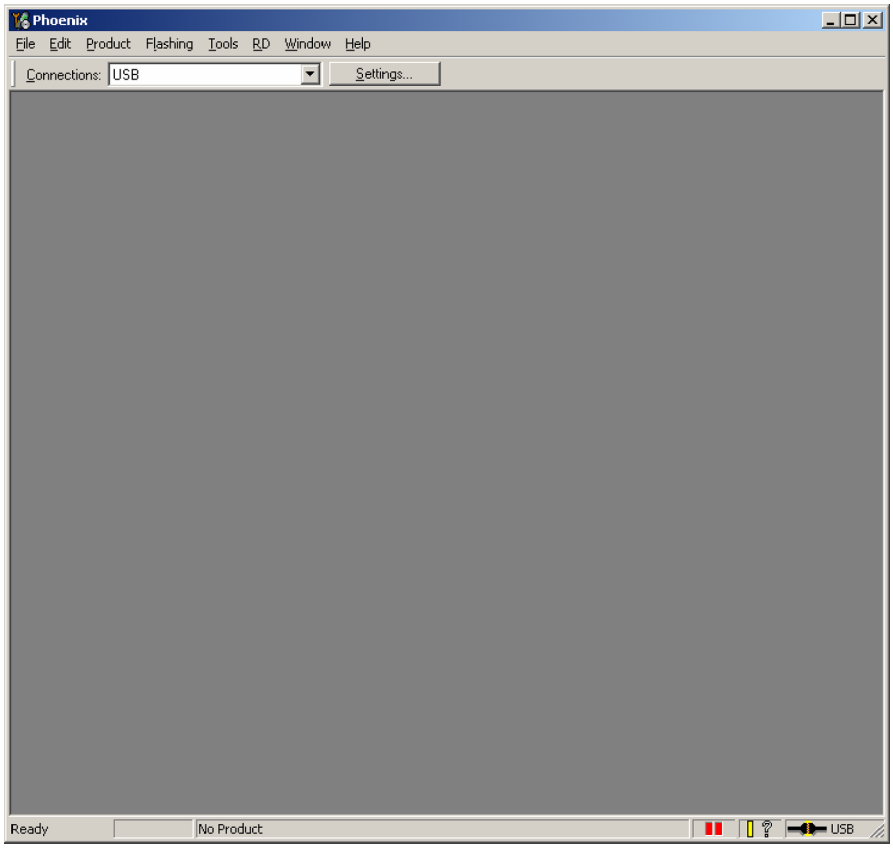
Tuning has to be performed always with assembled phone by using setup out of Rohde & Schwartz Shielding Box CMU-Z11, Coupler CMU-Z10 and USB Feed Through CMU-Z13. For details refer to chapter Service tools and service concepts.

## DVB-H tuning procedure

**Note:** All upper blocks with HWID15 (1PH_15a) must be tuned when upper block or a DVB-H antenna tuning component has been replaced.

## Steps

1. Choose connection type USB.




2. Choose operating mode to **Local**.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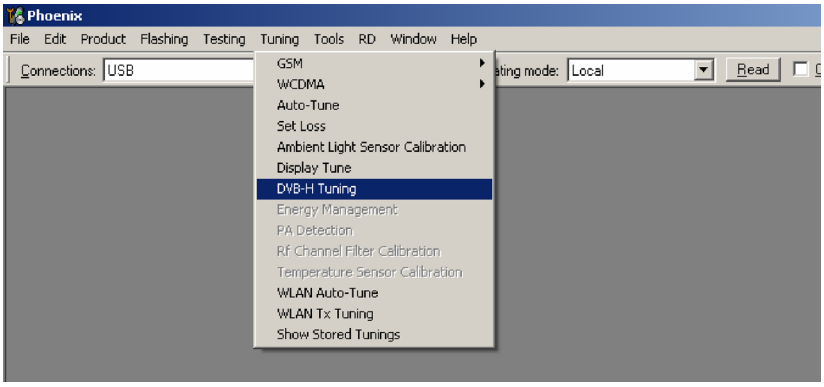
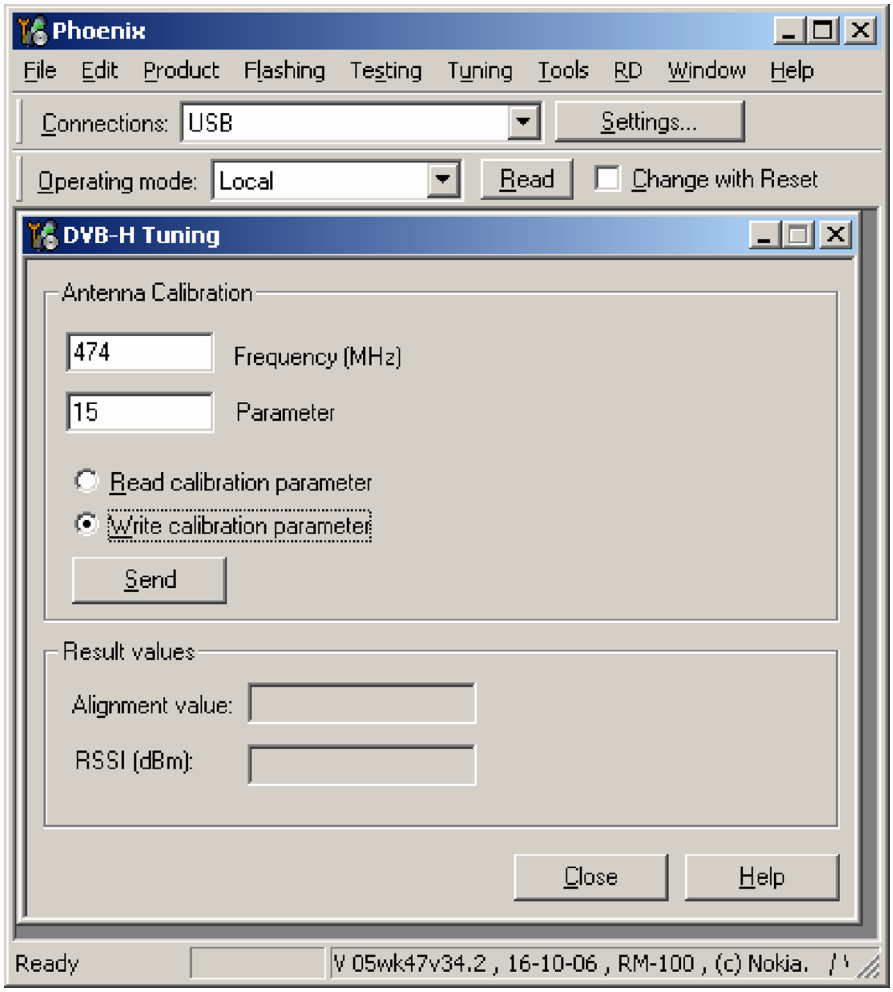
3. Select **Tuning / DVB-H tuning**.




4. Following window appears:




5. Set Frequency to 474 MHz:
   i Set the frequency in the signal generator to 475 MHz
   ii Set Amplitude to -30 dBm
   iii Set value “Parameter” to 15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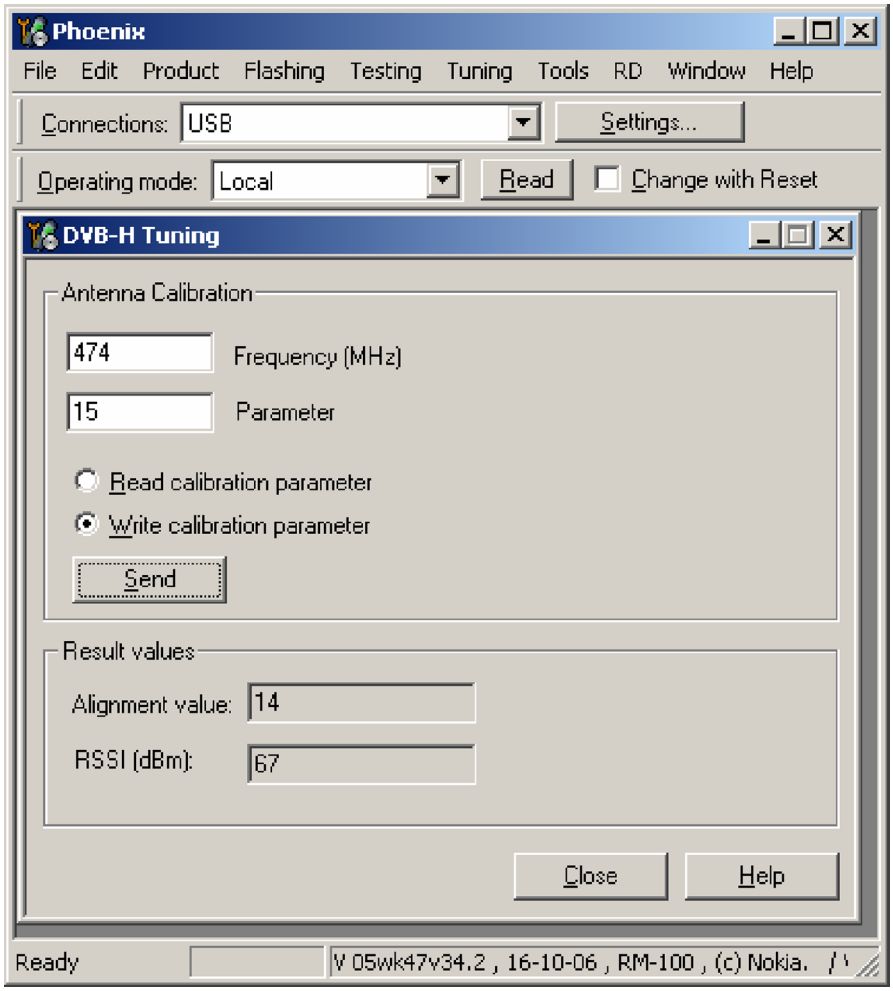
6. Select **Write calculation parameter** -> press **Send**.




7. RSSI value should be -60 dBm (±3 dBm) and Alignment value 14 (±15).
8. Repeat tuning also for frequencies 610 MHz and 746 MHz. Find setup and reference values from the following table:

**Table 19 DVB-H tuning values**

| Frequency | Signal level (=amplitude) | Parameter | RSSI value | Tolerance |
|---|---|---|---|---|
| 474 | -30dBm | 15 | -60dBm | +/- 3 dBm |
| 610 | -30dBm | 15 | -60dBm | +/- 3 dBm |
| 746 | -30dBm | 15 | -51dBm | +/- 3 dBm |

**Note:** Note: if RSSI is 0 dBm and Alignment value 255, tuning was not successfully completed -> repeat the tuning steps.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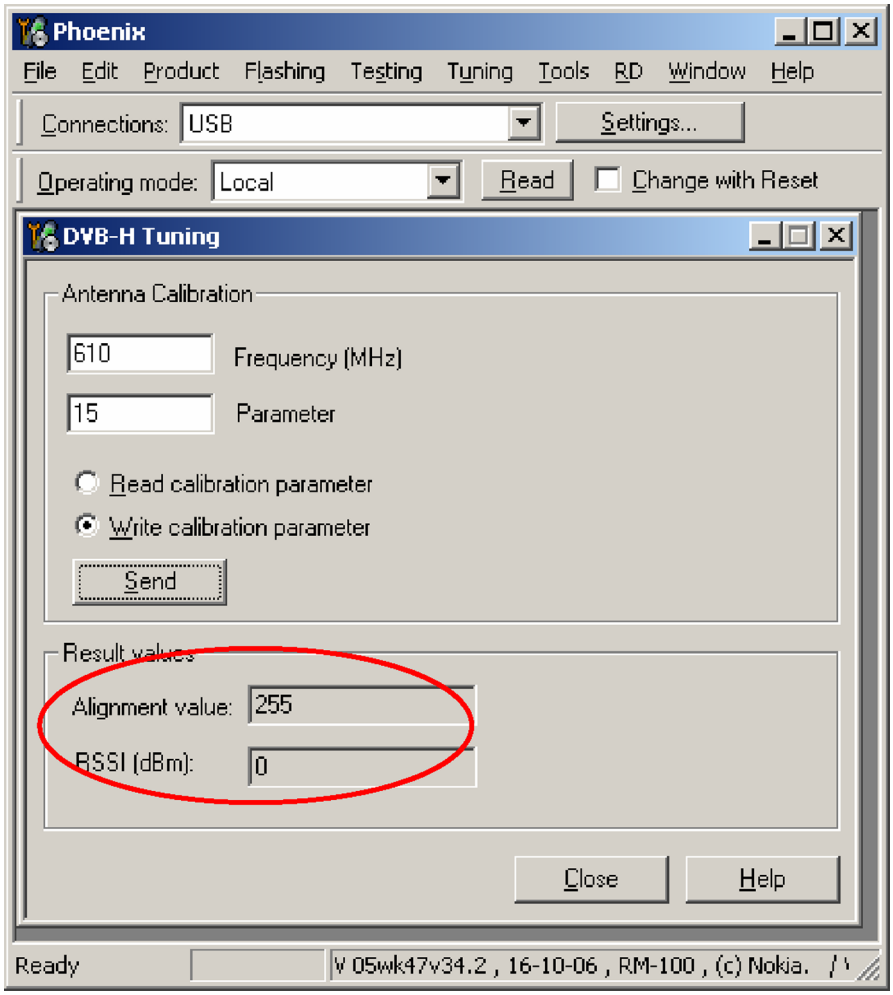


9. Finally read calibration parameter by selecting **Read calibration value** and press **Send**. (The purpose of this step is to check that the set Parameter value has been written on EEPROM).
10. Alignment value should be according to following table:

| Frequency | Alignment value | Tolerance |
|---|---|---|
| 474 | 14 | +/- 15 |
| 610 | 136 | +/- 15 |
| 746 | 225 | +/- 15 |

11. Finally measure RSSI values with Test set up – Option 2 with Rohde & Schwartz Shielding box.


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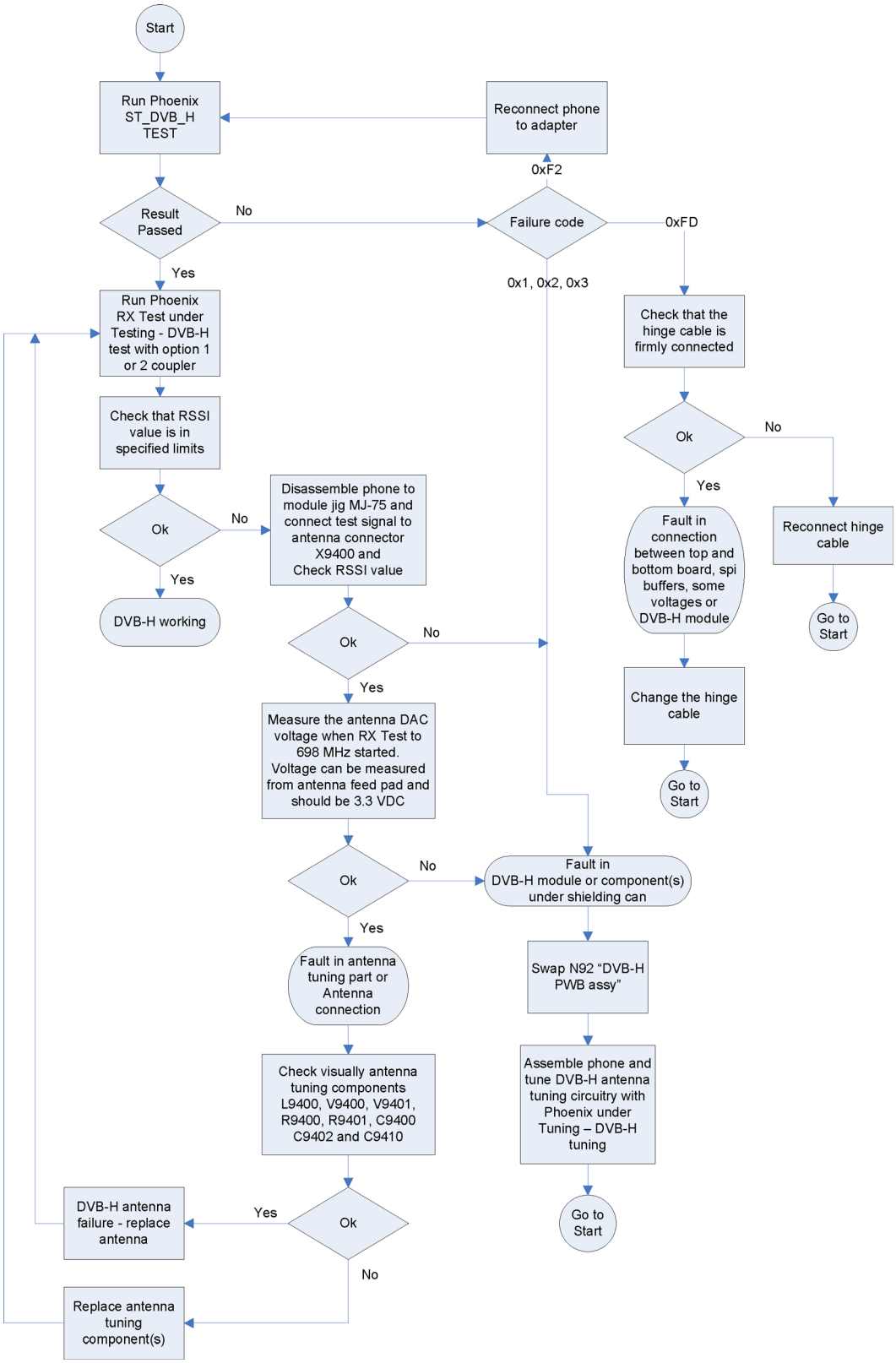
# DVB-H troubleshooting

## DVB-H troubleshooting flowchart

### Troubleshooting flow





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# 10 — System Module


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# Baseband description

## Baseband functional description

The device consists of two different main modules: bottom and top blocks. The bottom block consists of baseband, RF components and keyboard. The top block consists of displays, DVB-H engine, SD card reader, earpiece and IHF transducers. The hinge module consists of main camera. Connection between the bottom and top blocks are established by micro coaxial wires

Digital baseband consists of an ISA (Intelligent Software Architecture) based modem and Symbian based application sections. The modem functionality is in RAP, and the application processor acts as a platform for Symbian applications. The terms ISA and Symbian are used refer to the software environment of these devices.

The modem section consists of a RAP ASIC with NOR FLASH and SDRAM memory as the core. RAP supports WCDMA and GSM cellular protocols. The modem DDR SDRAM memory has 128 Mbits of memory and NOR flash has 128 Mbits of memory. RAP operates with the system clock of 38.4 MHz, which comes from the VCTCXO.

The application section includes an application processor ASIC with DDR/NAND combo memory as the core.

## Absolute maximum ratings

| Signal | Min | Nom | Max | Unit | Notes |
|---|---|---|---|---|---|
| Battery voltage (idle) | -0.3 | | +4.5 | V | Battery voltage maximum value is specified during charging is active |
| Battery voltage (Call) | +3.2 | | +4.3 | V | Battery voltage maximum value is specified during charging is active |
| Charger input voltage | -0.3 | | +20 | V | |
| Back-Up supply voltage | 0 | 2.5 | 2.6 | V | Maximum capacity of the backup power supply assumed to be 10 µAh. |

## Phone modes of operation

| Mode | Description |
|---|---|
| NO_SUPPLY | (dead) mode means that the main battery is not present or its voltage is too low (below EM ASIC N2200 master reset threshold) and that the back-up battery voltage is too low. |
| BACK_UP | The main battery is not present or its voltage is too low but back-up battery voltage is adequate and the 32kHz oscillator is running (RTC is on). |
| PWR_OFF | In this mode (warm), the main battery is present and its voltage is over EM ASIC N2200 master reset threshold. All regulators are disabled, PurX is on low state, the RTC is on and the oscillator is on. PWR_OFF (cold) mode is almost the same as PWR_OFF (warm), but the RTC and the oscillator are off. |
| RESET | RESET mode is a synonym for start-up sequence. In this mode certain regulators are enabled and after they and RFClk have stabilized, the system reset (PurX) is released and PWR_ON mode entered. RESET mode uses 32kHz clock to count the REST mode delay (typically 16ms). |
| SLEEP | SLEEP mode is entered only from PWR_ON mode with the aid of SW when the system's activity is low. |


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| Mode | Description |
|---|---|
| FLASHING | FLASHING mode is for SW downloading. |

## Voltage limits

| Parameter | Description | Value |
|---|---|---|
| VMSTR | Master reset threshold (N2200) | 2.2V (typ.) |
| VMSTR+ | Threshold for charging, rising (N2300) | 2.1V (typ.) |
| VMSTR- | Threshold for charging, falling (N2300) | 1.9V (typ.) |
| VCOFF+ | Hardware cutoff (rising) | 2.9V (typ.) |
| VCOFF- | Hardware cutoff (falling) | 2.6V (typ.) |
| SWCOFF | SW cutoff limit | ~3.2V |

The master reset threshold controls the internal reset of EM ASICs. If battery voltage is above VMSTR, N2300 charging control logic is alive. Also, RTC is active and supplied from the main battery. Above VMSTR, N2300 allows the system to be powered on although this may not succeed due to voltage drops during start up. SW can also consider battery voltage too low for operation and power down the system.

## Power key

The system boots up when power key is pressed (adequate battery voltage, VBAT, present).

Power down can be initiated by pressing the power key again (the system is powered down with the aid of SW). Power on key is connected to the EM ASIC N2200 via PWRONX signal.


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## Power distribution

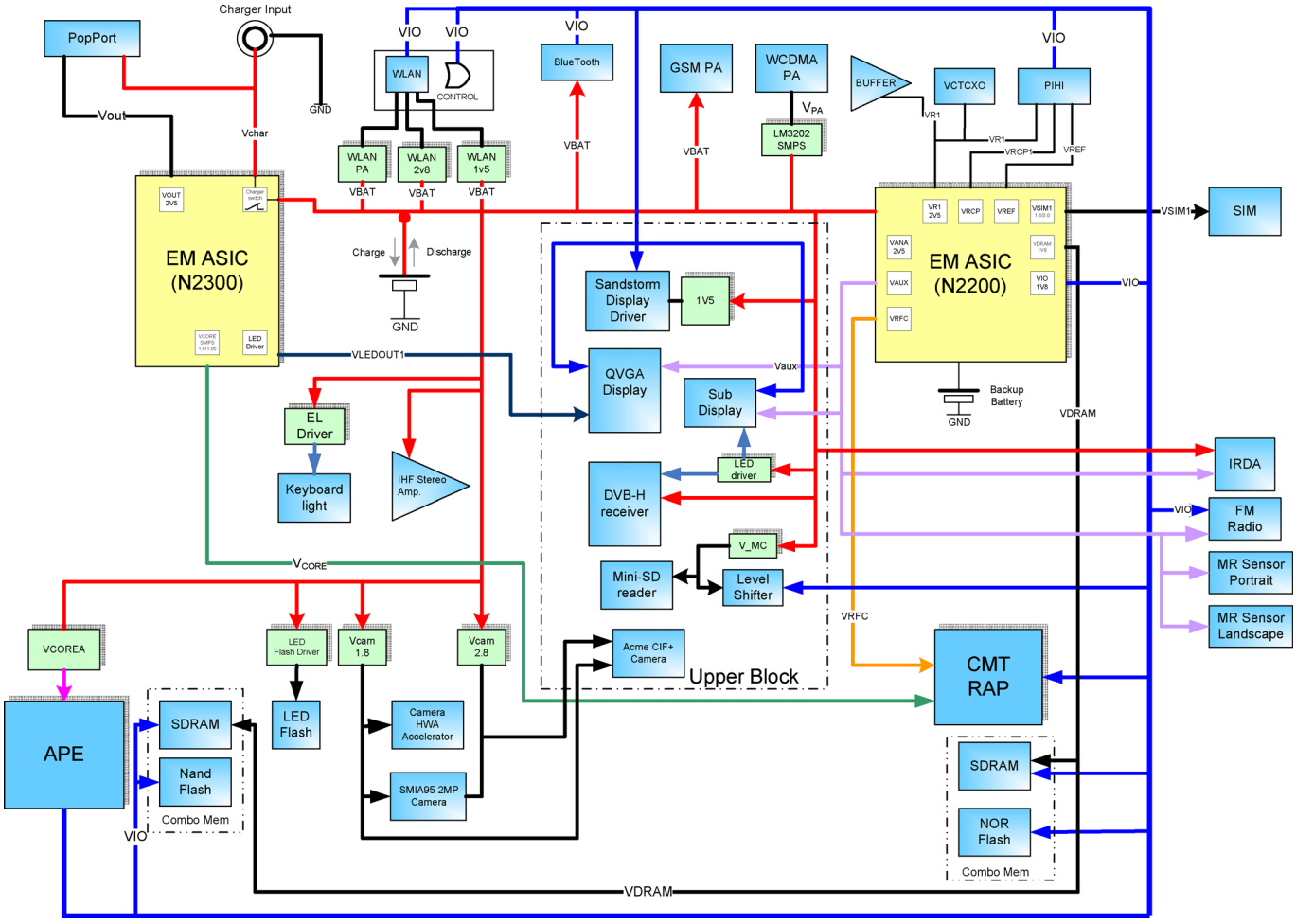


**Figure 88 Power distribution diagram**

Power supply components on the bottom block module:

- EM ASIC N2200
- EM ASIC N2300
- Application processor VCORE SMPS, N4200
- WLAN module supplies: N6300, N6301, N6303
- Camera and HWA supplies: N4441, N4442
- EL sheet power supply, N4430
- Flash LED driver, N4420

Power supply components on the top block module:

- Mini SD card regulator, N9350
- Display graphics accelerator power supply, N9110
- Sub display lights power supply, D9150

All the above are powered by the main battery voltage. Battery voltage is also used on the RF side for power amplifiers (GSM PA & WCDMA PA) and for RF ASICs.

Discrete power supplies are used to generate 1.5 V and 2.8 V for the cameras, 1.04 V/1.4 V for the application processor, 1.5 V for the display graphics accelerator, 3.0 V for SD card and D9150 generates 1.5*VBAT voltage for the sub display backlight LED. 1.5 V, 2.8 V and 3.0 V regulators are used to generate power supplu for


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WLAN module. The device supports both 1.8 V/3 V SIM cards which are powered by VSIM1. USB accessories which need power from the device are powered by N2300 / VOUT. The internal LED driver in N2300 is used to main display lights power supply.

## System power-up

After inserting the main battery, regulators started by HW are enabled. SW checks, if there is some reason to keep the power on. If not, the system is set to power off state by watchdog. Power up can be caused by the following reasons:

- Power key is pressed
- Charger is connected
- RTC alarm occurs
- MBUS wake-up

After that:

- N2200 activates sleep clock and VANA, VDRAM, VIO and VR1 regulators.
- Voltage appearing at N2200 RSTX pin is used for enabling N2300 ASIC.
- N2300 enables VCORE regulator and its internal RC-oscillator (600 kHz).
- VCTCXO regulator is set ON and RF clock (main system clock) is started to produce.
- N2200 will release PURX ~ 16ms after power up is enabled (the RF clock is then stable enough).
- Synchronizing clock (2.4MHz) for N2300 is started to be produced. After PURX is released and two rising edges of 2.4 MHz synchronous clock have been detected in SMPSClk input N2300 is starting to use that instead of 600kHz internal RC-oscillator.
- HW start-up procedure has been finalized and the system is up and running. Now it is possible for SW to switch ON other needed regulators.

## Clocking scheme

There are two main clocks in the system: 38.4MHz RF clock produced by VCTCXO in RF section and 32.768 kHz sleep clock produced by the EM ASIC N2200 with an external crystal.

RF clock is generated only when VCTCXO is powered on by the EM ASIC regulator. Regulator itself is activated by SleepX signals from both RAP and application processor. When both CPUs are on sleep, RF clock is stopped.

RF clock is used by RAP, which provides (divided) 19.2MHz SysClk further to the application processor. Both RAP and the application processor have internal PLLs which then create clock signals for other peripheral devices/interfaces like RS MiniSD, SIM, CCP, I2C and memories.

**32k Sleep Clock** is always powered on after startup. Sleep clock is used by RAP and the application processor for low-power operation.

**SMPS Clk** is 2.4MHz clock line from RAP to EM ASIC N2300 used for switch mode regulator synchronizing in active mode. In deep sleep mode, when VCTCXO is off, this signal is set to '0'-state.

**BT Clk** is 38.4MHz signal from the RF ASIC to the Bluetooth system.

**CLK600** is 600KHz signal from EM ASIC N2300 to APE VCORE SMPS. The clock source is internal RC oscillator in EM ASIC (during the power-up sequence) or RAP SMPS Clk divided by 4 after the power-up sequence.


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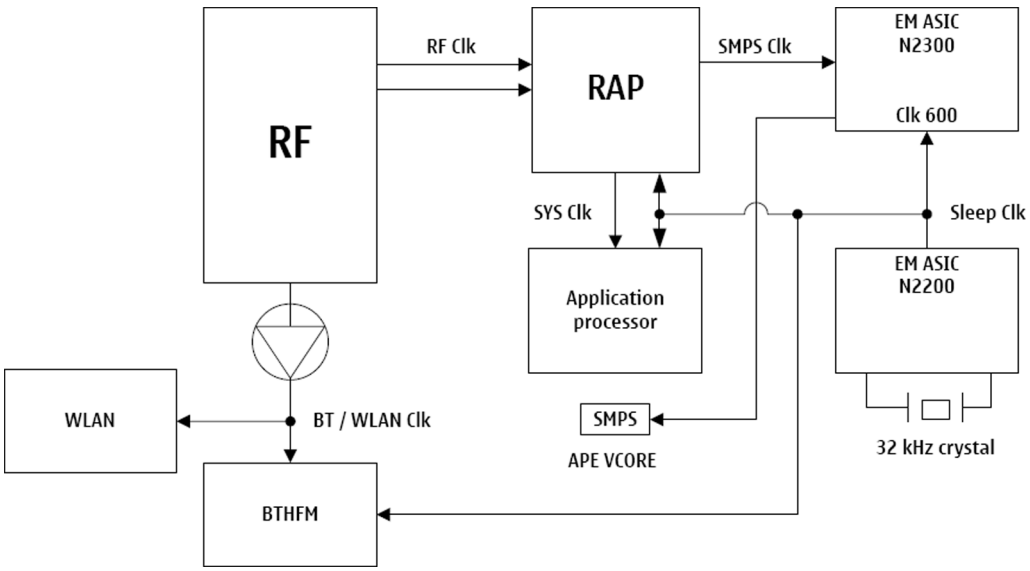


**Figure 89 Clocking scheme**

## Bluetooth

The Bluetooth chip is integrated together with FM radio chip into the BTHFM module. The Bluetooth and WLAN solutions share a common antenna. The BT antenna path passes through the WLAN module, and whilst BT and WLAN are both active, the use of the antenna is negotiated via the BT-WLAN interacitivity lines WLAN_BT(6:0).

When WLAN is inactive, the BT acquires the antenna by the action of the BT_CLOCK_REQUEST line, which enables the WLAN power regulators N6300, N6301 and N6303. These regulators power up part of the WLAN module, thus enabling only its internal RF switch for BT use, whilst the remainder of the WLAN functionality remains sleeping.

Bluetooth provides a fully digital link for communication between a master unit and one or more slave units.

The system provides a radio link that offers a high degree of flexibility to support various applications and product scenarios. Data and control interface for a low power RF module is provided. Data rate is regulated between the master and the slave.


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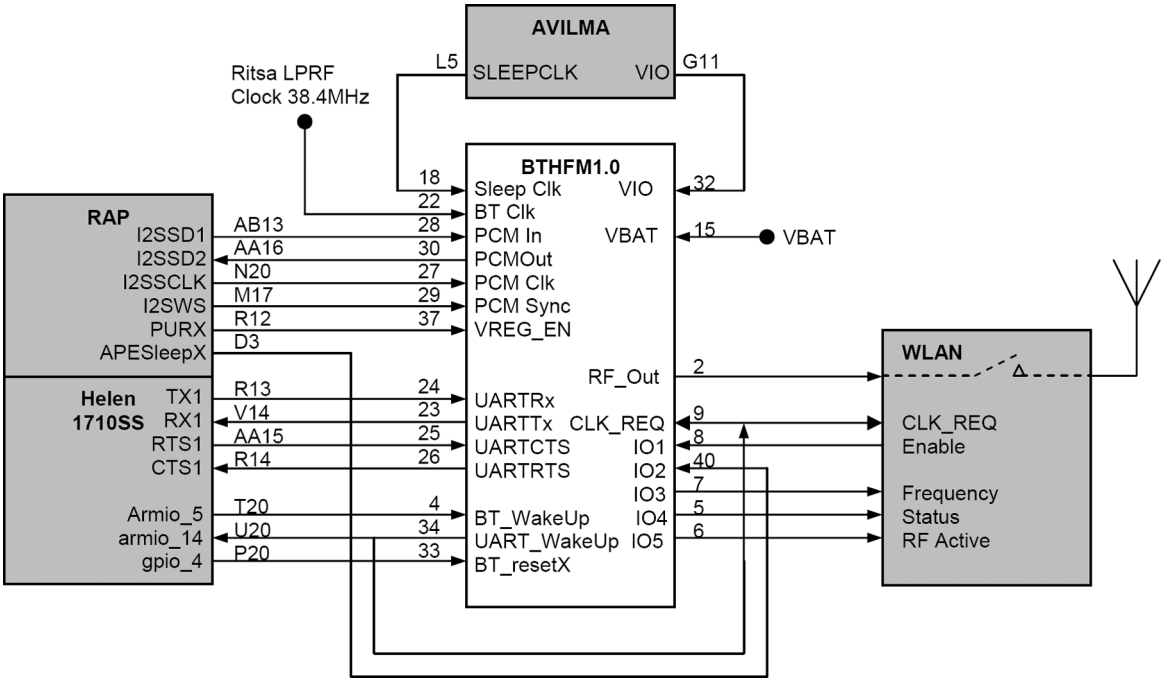


**Figure 90 Bluetooth interfaces**

## FM radio

The FM radio is an integrated circuit which is in combined BTHFM module with Bluetooth chip, controlled by MCU software through a serial bus interface. The wires of the headset are used as poles of the antenna, and no other antenna is needed for FM radio reception.

The antenna for the FM radio is provided by plugging in an external wired headset to the system connector. It is not possible to listen to the FM radio without a wired headset connected. The FM radio is controlled by I2C commands from RAP. The audio output of the FM radio is fed to the headset via AVILMA EM ASIC N2200 and analog switch, so the rest of the phone can sleep while the FM radio is active.


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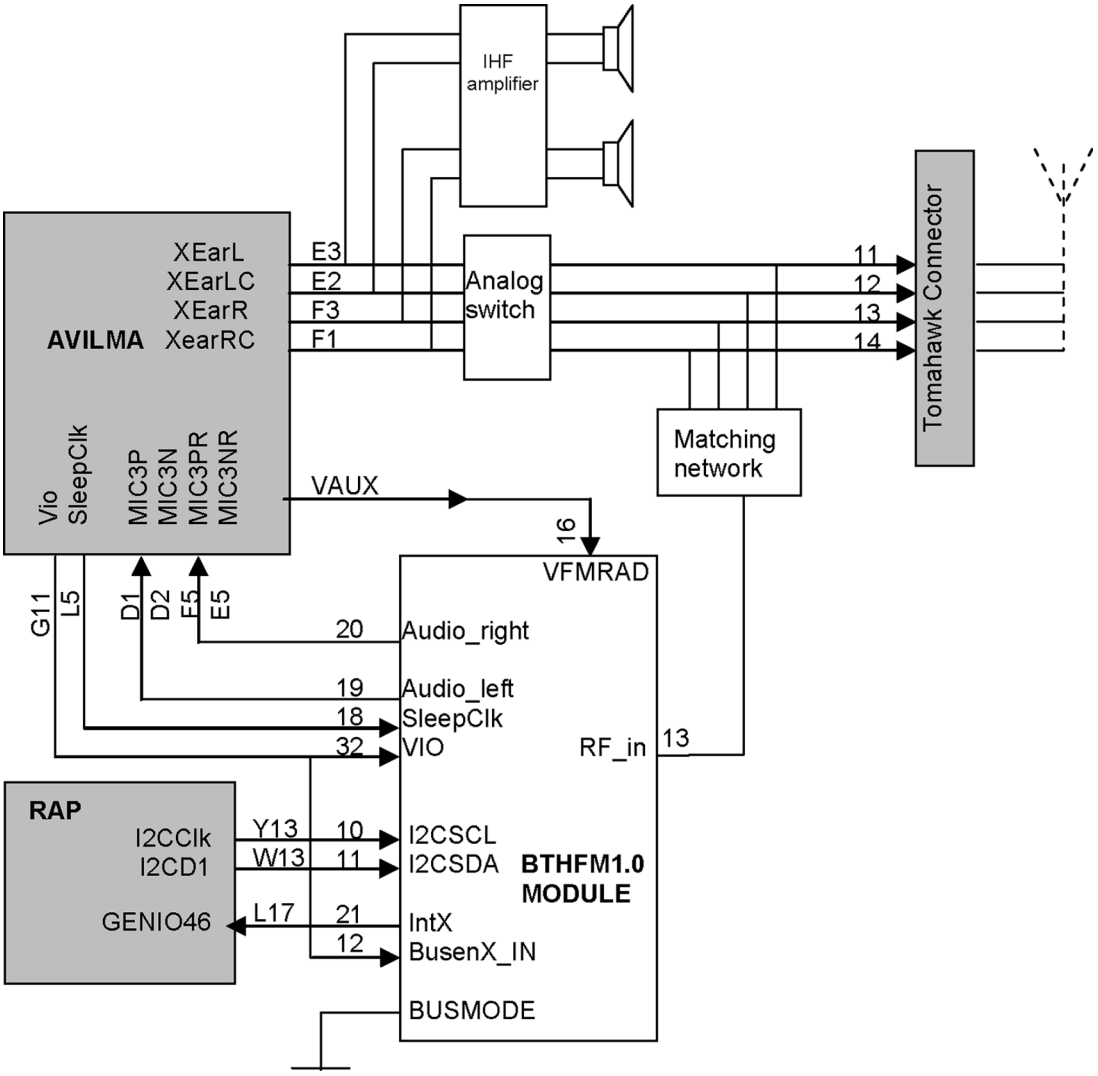


**Figure 91 FM radio module interface to engine**

## USB

USB (Universal Serial Bus) provides a wired connectivity between a USB host PC and peripheral devices.

USB is a differential serial bus for USB devices. USB controller supports USB specification revision 2.0 with full speed USB (12 Mbps). The device is connected to the USB host through the system connector. The USB bus is hot plugged capable, which means that USB devices may be plugged in/out at any time.

## SIM interface

The device has one SIM (Subscriber Identification Module) interface. It is only accessible if battery is removed. The SIM interface consists of an internal interface between RAP and EM ASIC N2200 and of an external interface between N2200 and SIM contacts. The main SIM interface functionality is in RAP while N2200 takes care of power up/down, card detection, ATR (Answer To Reset) counting and level shifting. For N2200 external SIM IF connections, see section SIM interface connections.

The SIM IF is shown in the following figure:


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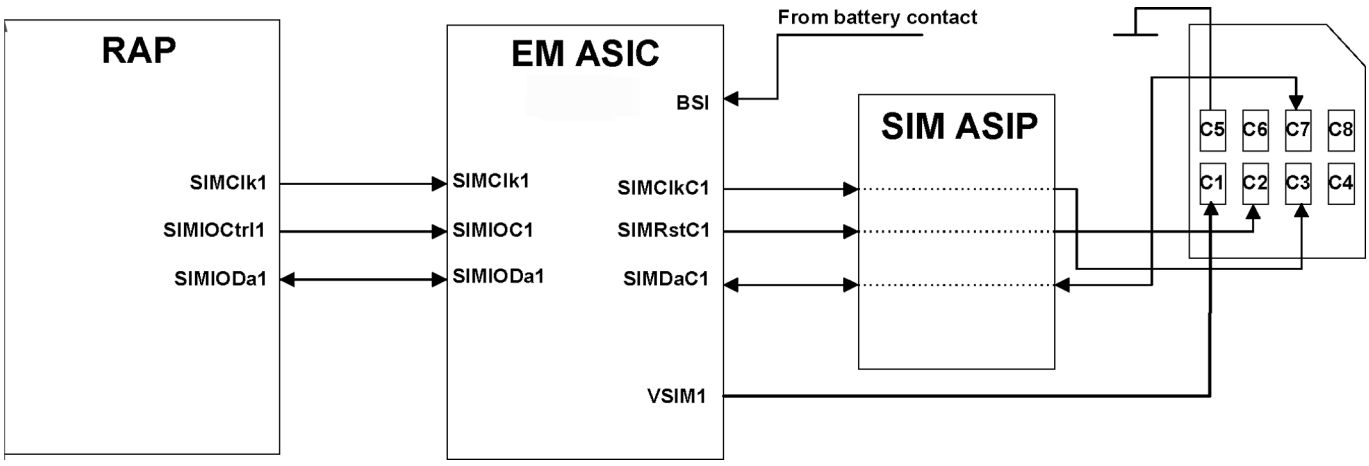


**Figure 92 SIM interface**

## IrDA interface

IrDA specifies a reliable, fully digital peer-to-peer data link between IrDA units at data rates from 9600 bits/s to 4 Mbits/s. The link is based on the serial transmission of data as pulses of infra red light at the wave length of 870 nm and angles of +-15 degrees at the range 0 - 50 to 100 cm. Because of these restrictions and the optical nature of the link, the transmission is not omnidirectional but focused and only reaches a peer at a limited line-of-sight distance from the transmitter thus not disturbing any other units in the neighbourhood.

## Mini SD card interface

The mini SD card connector is mounted on the ‘sub’ block PWB. The mini SD card is supplied with 3 V supply voltage. The detection of the mini SD card removal/insertion is done by a switch in the memory card door on the mechanics. Removing the mini SD card while writing to the card may corrupt data in the SD card. The switch is directly connected to host and it gives an interrupt to the SW while the status of the switch is changed. SW turns power off on the mini SD card by switching off the mini SD card and level-shifter power supply (V_MC). There is also switch inside in the mini SD card connector and when the mini SD card connector switch status changes the card should be identified if card exists.

## WLAN interface

A Wireless Local Area Network (WLAN) is a flexible data communication system in which a mobile user can connect to a local area network through a wireless connection. A standard, which specifies the technologies for WLAN, is called IEEE 802.11. The WLAN module is controlled by the application processor with SPI interface. The WLAN-module incorporates switching for Bluetooth antenna.


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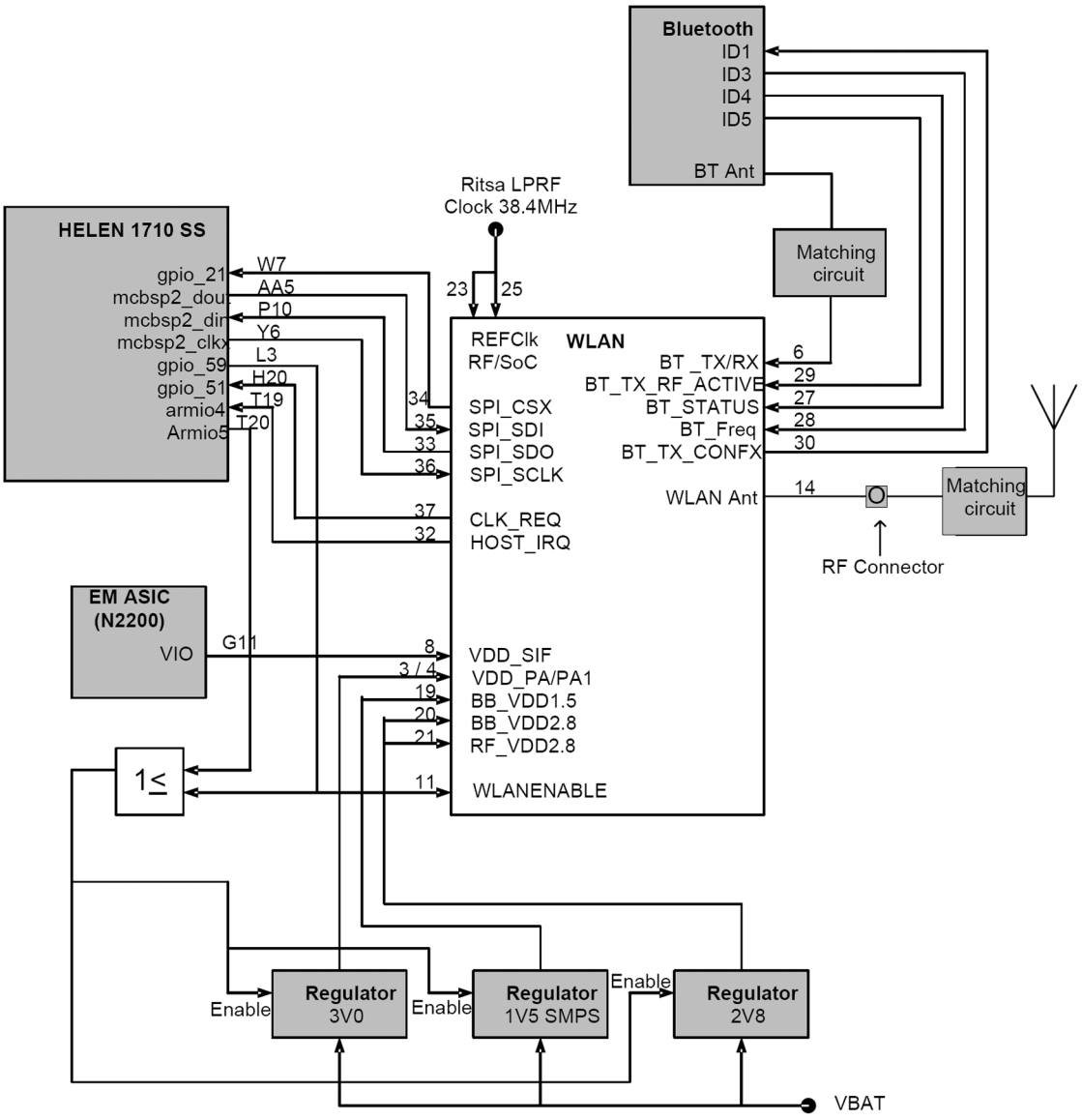


## DVB-H interface

RM-100 has an integrated DVB-H receiver. The receiver is built into a module form-factor located in upper block of RM-100. The DVB-H receiver consists of 2 key components, RFIC and BBIC. It is able to receive 6, 7 or 8MHz (channel width depending on used standard in different countries) DVB-H transmissions over 470-750MHz band. The receiver decapsulates IP packets (e.g. audio and video data) from the stream and forwards them to the application processor. The module contains all needed DVB-H receiver functions excluding antenna. Antenna consists of antenna element and matching circuitry. Matching circuitry is controlled via DVB-H receiver.The DVB-H module is controlled by OMAP1710SS with SPI interface that is common with displays. The DVB-H module is set on and off by DVB_H_Ena signal that is controlled by OMAP 1710SS. DVB-H activity signal is used for synchronizing SD memory card operation during DVB-H reception.


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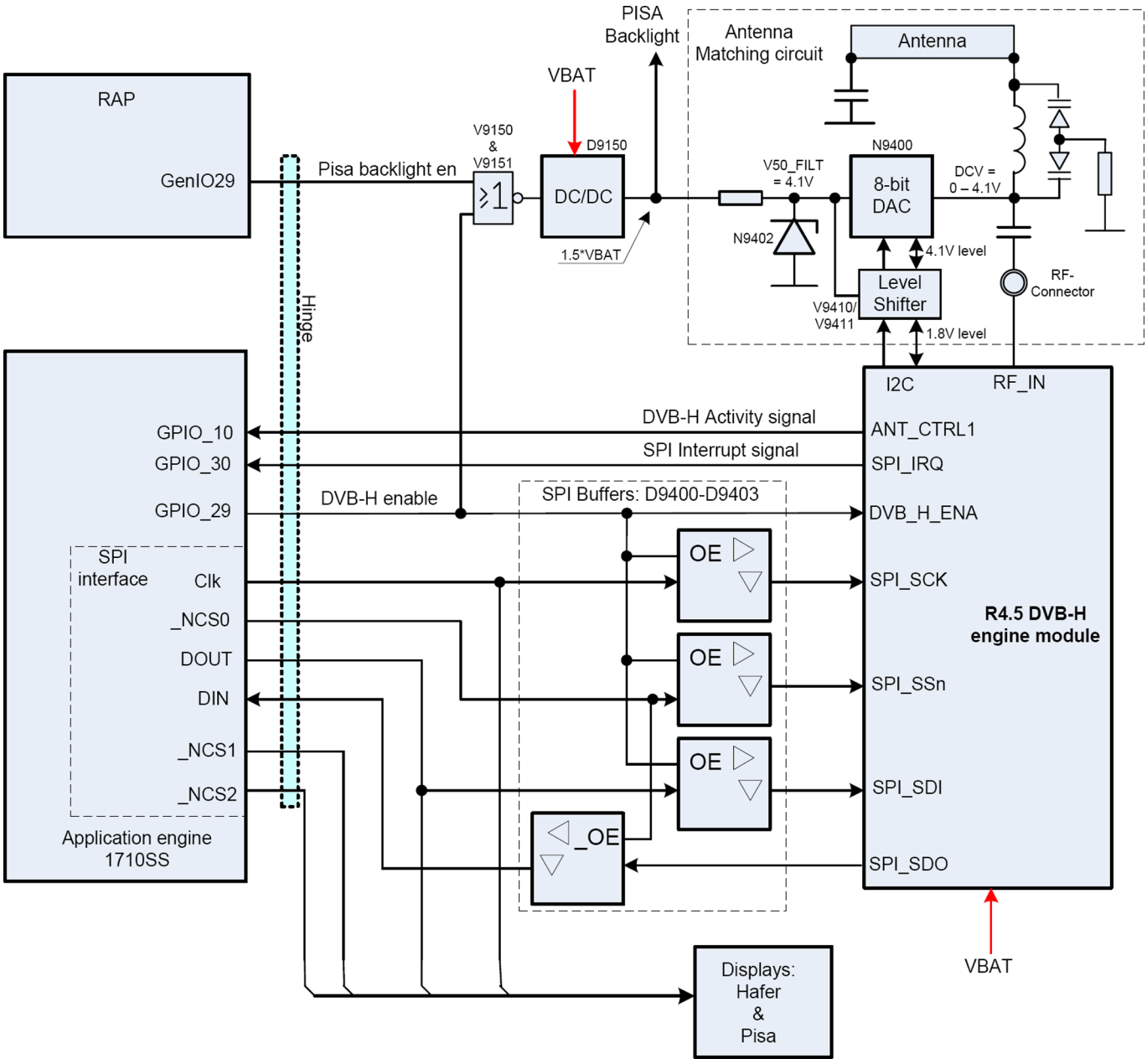


## Battery interface

The battery interface supports a 3-pole battery interface. The interface consists of three connectors: VBAT, BSI and GND.

The BSI line is used to recognize the battery capacity by a battery internal pull down resistor.

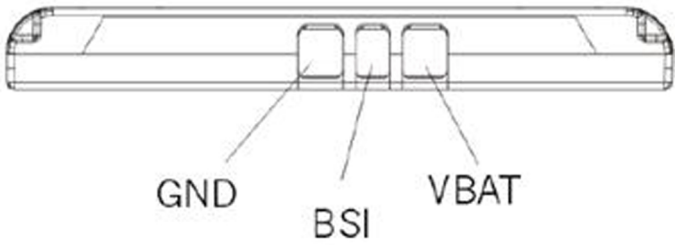


**Figure 93 Battery pin order**


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## Camera interfaces

### *Main camera interface*

The main camera of the device uses a SMIA95 2.0 mega pixel module producing pictures with resolution of up to 1600x1200. Cameras image processing is done in specific camera hardware accelerator.

The camera regulator N4441 powers the digital parts of the camera and N4442 powers the analogue parts.

### *Main camera specifications*

This section describes the mechanical construction of the camera module for getting a better understanding of the actual mechanical structure of the module.

| | |
|---|---|
| Sensor type | CMOS |
| Sensor photo detectors (effective) | 1600x1200 |
| F number/Aperture | 3.2 |
| Focus range | 70cm -> infinity |
| Still image resolutions | 1600x1200, 1152x864 and 640x480 |
| Still images file format | EXIF (.jpg) |
| Video resolutions | 352x288 and 176x144 |
| Video clip length | 30sec short mode or 1 hour free mode |
| Video file format | 3GPP, (*.3gp) or MPEG-4 (*.mp4) |
| Exposure control | Automatic |
| White balance | Automatic |
| Colours | 16.7 Million, 24bit |

### *Front camera specifications*

The front camera has a resolution of CIF+ (382x320) and is used mainly for video calls. It can also be used to take still images and video clips.

The front camera control and image processing is done on the same hardware accelerator as the main camera.

The front camera has the following characteristics.

| | |
|---|---|
| Sensor type | CMOS |
| Sensor photo detectors (effective) | 384x320 |
| F number/Aperture | 2.8 |
| Focus range | 25cm -> 1m |
| Still image resolutions | 320x240 |
| Still images format | EXIF (.jpg) |
| Video resolutions | 352x288, 176x144 or 128x96 |
| Video clip length | 30sec short mode or 1 hour free mode |
| Video file format | 3GPP, (*.3gp) or MPEG-4 (*.mp4) |
| Exposure control | Automatic |


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| | |
|---|---|
| White Balance | Automatic |
| Colours | 16.7 Million, 24bit |

### Flash LED

The device main camera has a flash LED located directly beside the camera providing better lighting conditions in darker environment.

The flash LED consists of 4 white LEDs in series in one module. The module has a lens for directing the light to right direction.

The flash is controlled with same hardware accelerator that controls both cameras.

The flash module also contains one red LED die that is used as an indicator during video shooting. The indicator LED is controlled with the application processor.

### User interface

The user interface of the handset consists of two displays, keys and cameras.

UI features:

- Flash LED with privacy light (red light)
- Front facing camera for video calls
- Main camera in hinge
- Camera accelerator ASIC
- Main power key
- ITU keymat and media keys. Phone mode dependent layout and key response.
- Dedicated camera shutter and volume adjustment keys
- Main display
- Sub display in cover
- Display accelerator ASIC
- Magneto resistive sensors to detect four different phone modes

### Phone position sensors

The position (closed, portrait etc.) of the hinge is detected by two MR-sensors. One in the upper and lower PWB. Magnets are placed to inside hinge.


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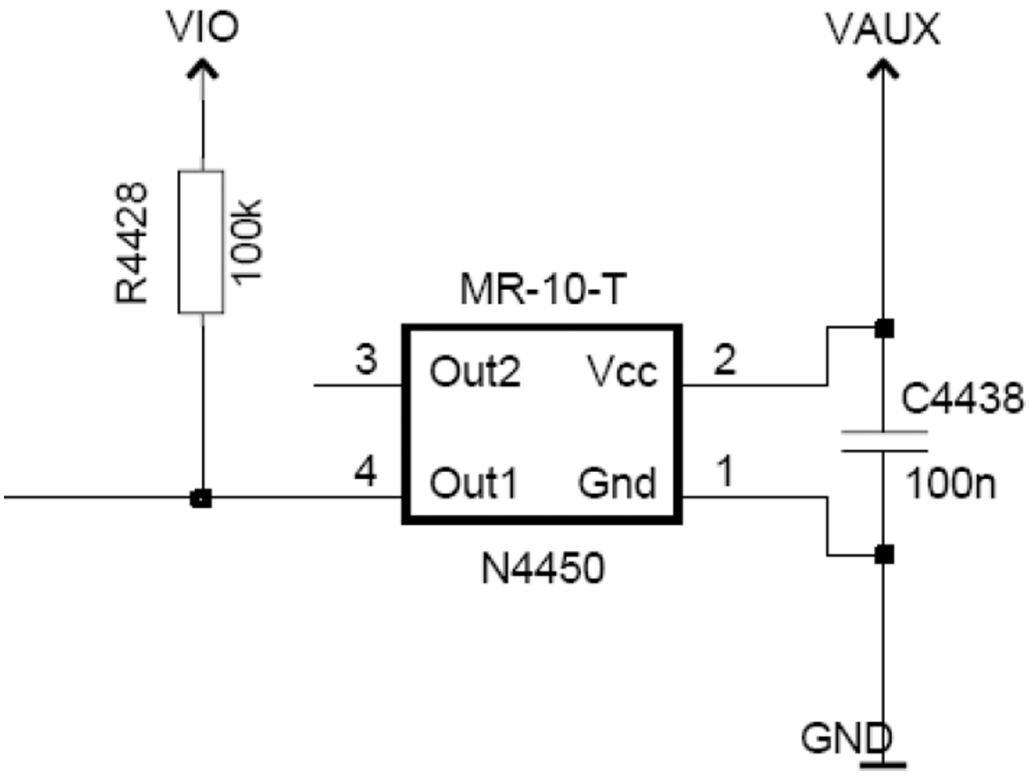


**Figure 94 Lower block sensor schematic**

## *Keyboards*

The device keyboard has normal ITU 3x4 keyboard and media keys. Camera and volume buttons are located in the side of phone. Power button is in upper block. All the keys are part of the same matrix and are connected directly to the APE ASIC through ASIPs.

**Table 20 Keyboard placement matrix in Portrait mode**

| | Column 0 | Column 1 | Column 2 | Column 3 | Column 4 | Column5 |
|---|---|---|---|---|---|---|
| Row 0 | Up | Right | Clear | | SK1 | |
| Row 1 | Left | Down | Select | Application | SK2 | |
| Row 2 | Num_1 | Num_2 | Num_3 | Prev | End | |
| Row 3 | Num_4 | Num_5 | Num_6 | Next | Multimedia | Camera |
| Row 4 | Num_7 | Num_8 | Num_9 | Stop | Send | Vol_up |
| Row 5 | * | SK3 | Num_0 | # | Play/ Pause | Vol_down |


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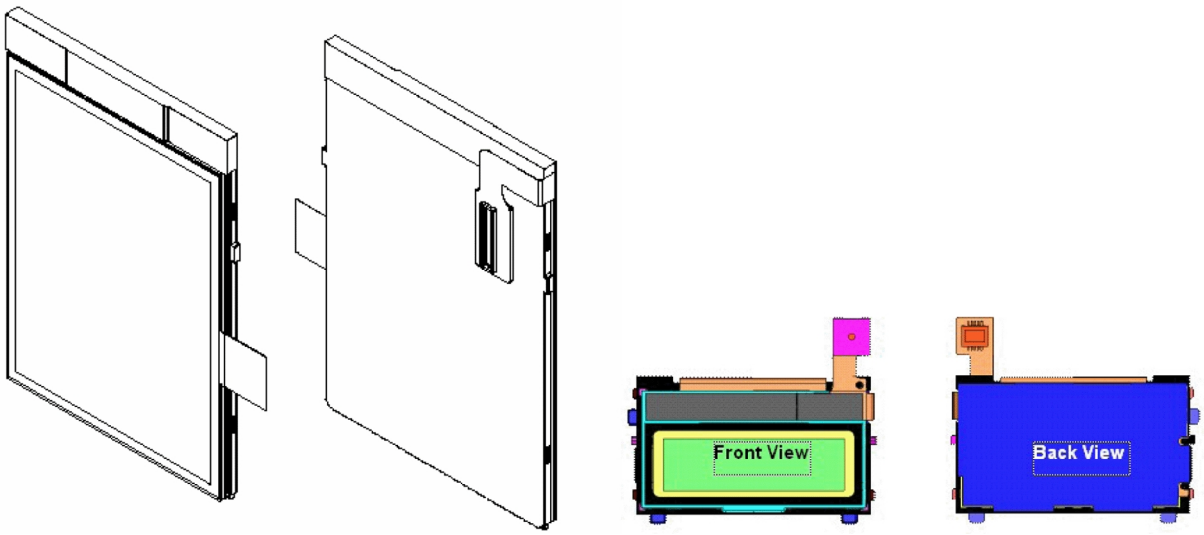
## *Display interface*

### Display module mechanical concepts




Main display features:

- 16M colours (24-bit mode)
- partial display function power saving by pausing display process on part of the screen
- no full-image built in RAM, so display accelerator is needed

The display has two different operating modes:

1 normal mode, full screen, 16M colours

2 normal partial mode, 8 colours but only part of the display is active

Sub display features:

- 64k colours (16-bit mode)
- No separate partial mode for power saving. The sub display is set to sleep mode when not used.

The interconnection between the main LCD module and the PWB is implemented with a 50-pin board-to-board connector. The sub display interconnection has 10-pin board-to-board connector.

Displays do not require any tunings in service.

## *Display and keyboard backlight*

The device uses the internal LED driver in N2300 to drive main display 6 LEDs.

The keyboard is illuminated by EL-sheet and is driven by N4430.

The sub display backlight is powered by charge pump type of power supply D9150.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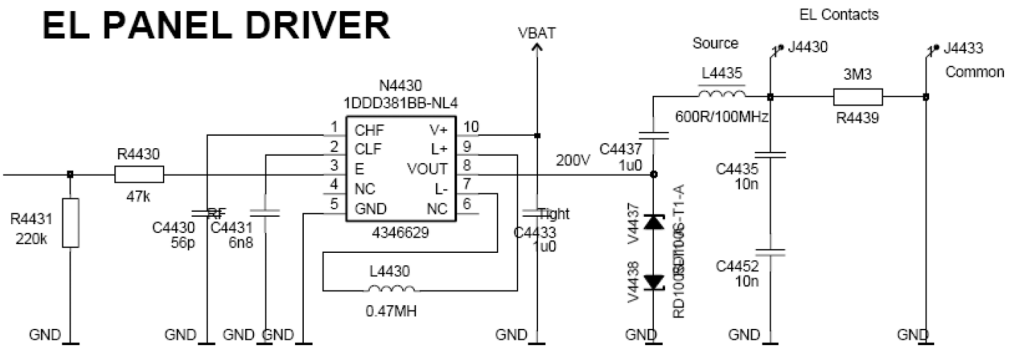


**Figure 95 EL driver**

## ASICs

### *RAP3GS ASIC*

RAP3GS ASIC is a 3G Radio Application Processor.

### *Application engine processor*

OMAP1710SS (speed sorted version) is application engine processor.

### *EM ASIC N2200*

The EM ASIC (N2200) includes the following functional blocks:

- Start up logic and reset control
- Charger detection
- Battery voltage monitoring
- 32.768kHz clock with external crystal
- Real time clock with external backup battery
- SIM card interface
- Stereo audio codecs and amplifiers
- A/D converter
- Regulators
- Digital interface (CBUS)

### *EM ASIC N2300*

The EM ASIC (N2300) includes the following functional blocks:

- Core supply generation
- Charge control circuitry
- Level shifter and regulator for USB/FBUS
- Current gauge for battery current measuring
- LED driver for display backlights
- Digital interface (CBUS)


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## Device memories

### *RAP memories NOR flash and SDRAM*

POP2 memory is stacked on the RAP. Modem memory consists of 128 Mbit SDRAM and 128 Mbit NOR flash memories.

### *Combo memory*

The application memory of the device consists of NAND/DDR combo memory. The stacked DDR/NAND application memory has 512 Mbit of DDR memory and 1024 Mbit of flash memory.

# Audio concept

## Audio HW architecture

The functional core of the audio hardware is built around two ASICs: RAP CMT engine ASIC and the mixed signal EM ASIC N2200. Due to stereo IHF solution there is also analog switch N2100 to control the audio signal to system connector.

There are four audio transducers:

- 7mm x 11mm dynamic earpiece
- 2 pcs 11 x 15 mm dynamic speaker
- electret microphone module

All galvanic audio accessories are connected to the system connector accessory connector.

A Bluetooth audio module that is connected to RAP supports Bluetooth audio functionality.

There is a separate application processor for Symbian applications.

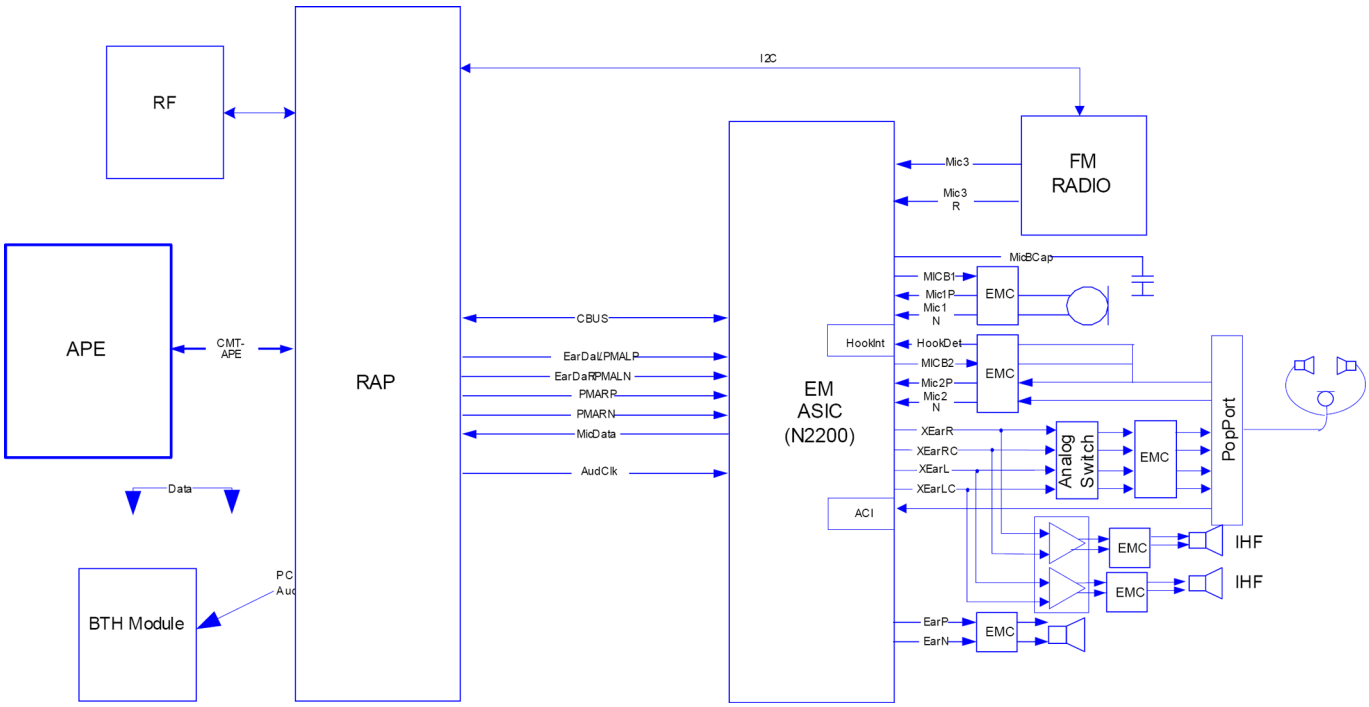


**Figure 96 Audio HW block diagram**

## Internal microphone

The internal microphone is used for HandPortable (HP) and Internal HandsFree (IHF) call modes.


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An analogue electret microphone is connected to the EM ASIC (N2200) Mic1P via asymmetric electrical connection.

The microphone is biased by the EM ASIC MicB1 bias voltage output.

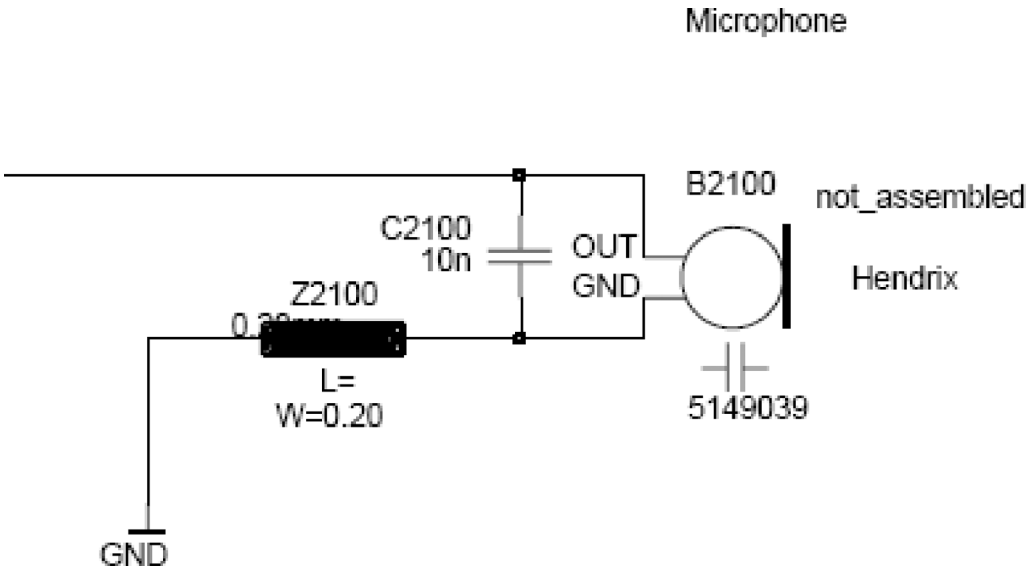


**Figure 97 Internal microphone circuitry**

## External microphone

External micrphone is used in accessory mode.

Galvanic accessories are connected to the system connector.

External microphone uses EM ASIC (N2200) Mic2P and Mic2N inputs.

Accessory audio mode is automatically enabled/disabled during connection/disconnection of dedicated phone accessories.

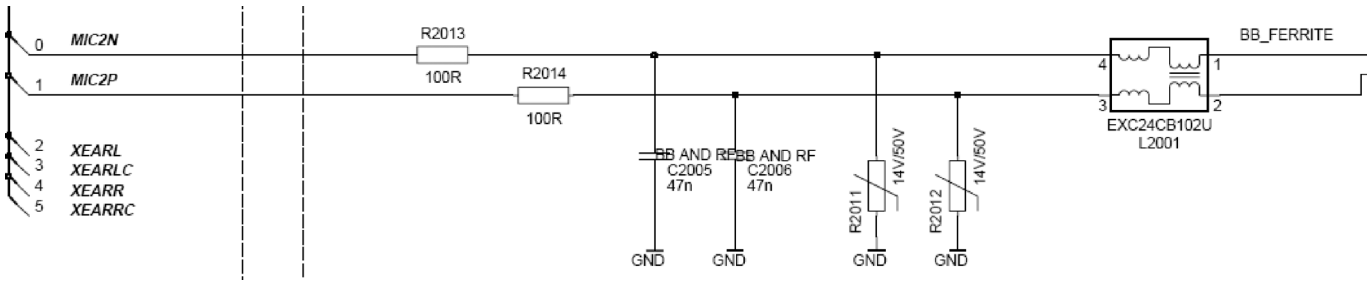


**Figure 98 External microphone circuitry (system connector connects to right side)**

## Internal earpiece

The internal earpiece is used in the HandPortable (HP) call mode. A dynamic 7 x 11mm earpiece capsule is connected directly to the EM ASIC (N2200) differential outputs EarP and EarN through the coax cable, top block PWB and the flex.

## External earpiece

All galvanic accessories are connected to the system connector.

The accessory audio mode is automatically enabled/disabled during connection/disconnection of dedicated phone accessories.


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The EM ASIC (N2200) provides two output channels in either single-ended or differential format. N2200 outputs XearL and XearLC form the left channel audio output, and XearR and XearRC the right channel audio output. XearLC and XearRC are the ground pins if the output works in a single-ended operation.

In the system connector side, HSEAR P and HSEAR N form the left channel output, and HSEAR R P and HSEAR R N the right channel output. Respectively, HSEAR N and HSEAR R N are the ground pins if the output works in a single-ended operation.

Because of stereo IHF solution a separate analog switch, N2100, is needed to switch external earpiece lines off when needed.

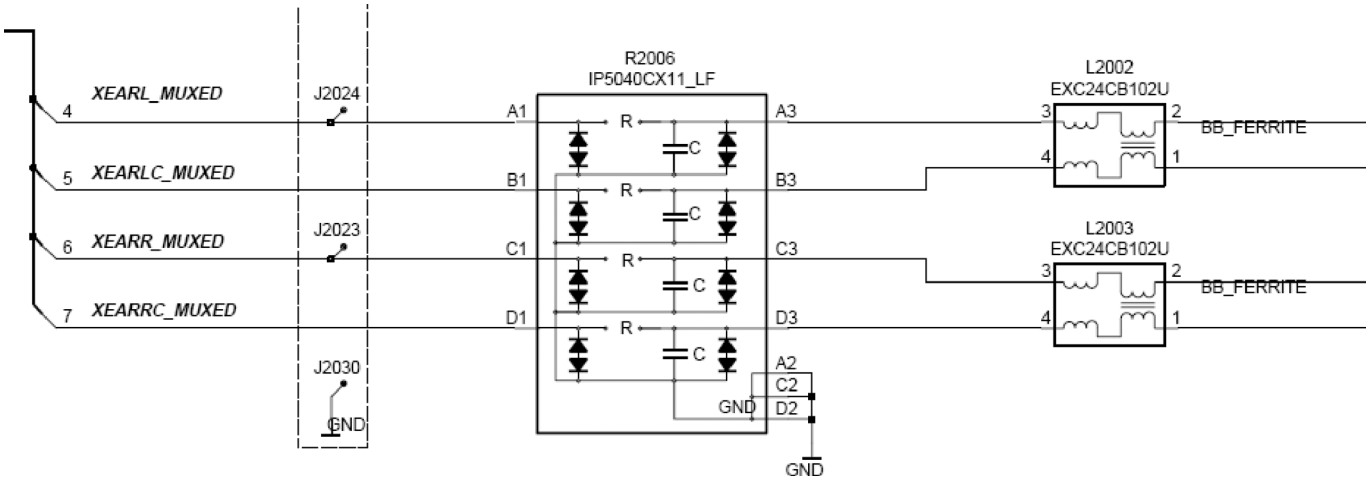


**Figure 99 External earpiece circuitry (system connector connected on the right)**


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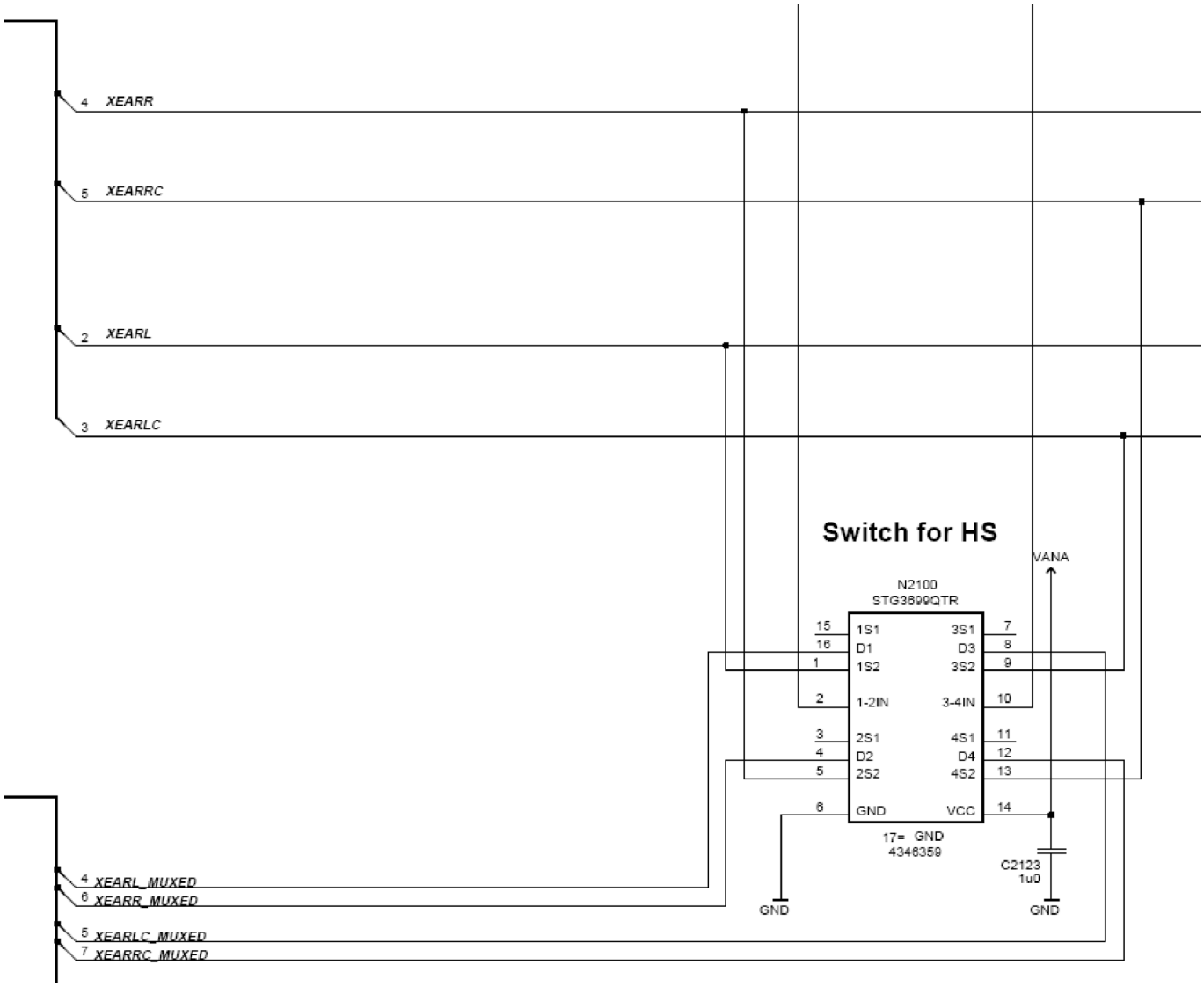


**Figure 100 Switch for external earpiece**

## Internal handsfree speaker

The internal handsfree speakers are used in Internal HandsFree (IHF) mode. A dynamic 11 x 15 mm speakers are connected to the EM ASIC (N2200) differential XEar outputs: XEarL,XEarLC, XEarR and XEarRC.

The N2201 IHF amplifier is a Class-D Amplifier.


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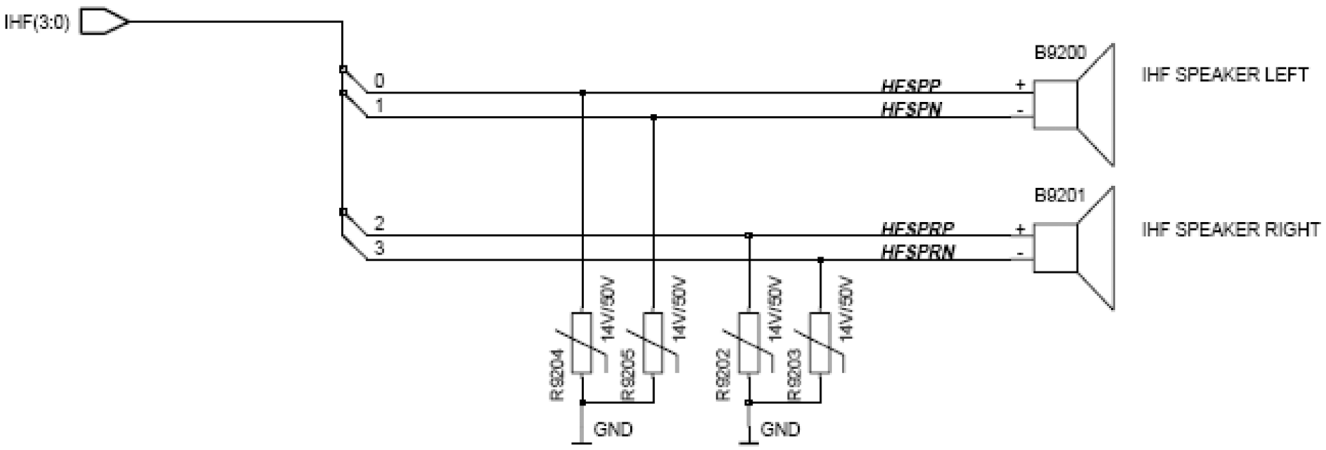


**Figure 101 Internal handsfree speakers (upper block)**

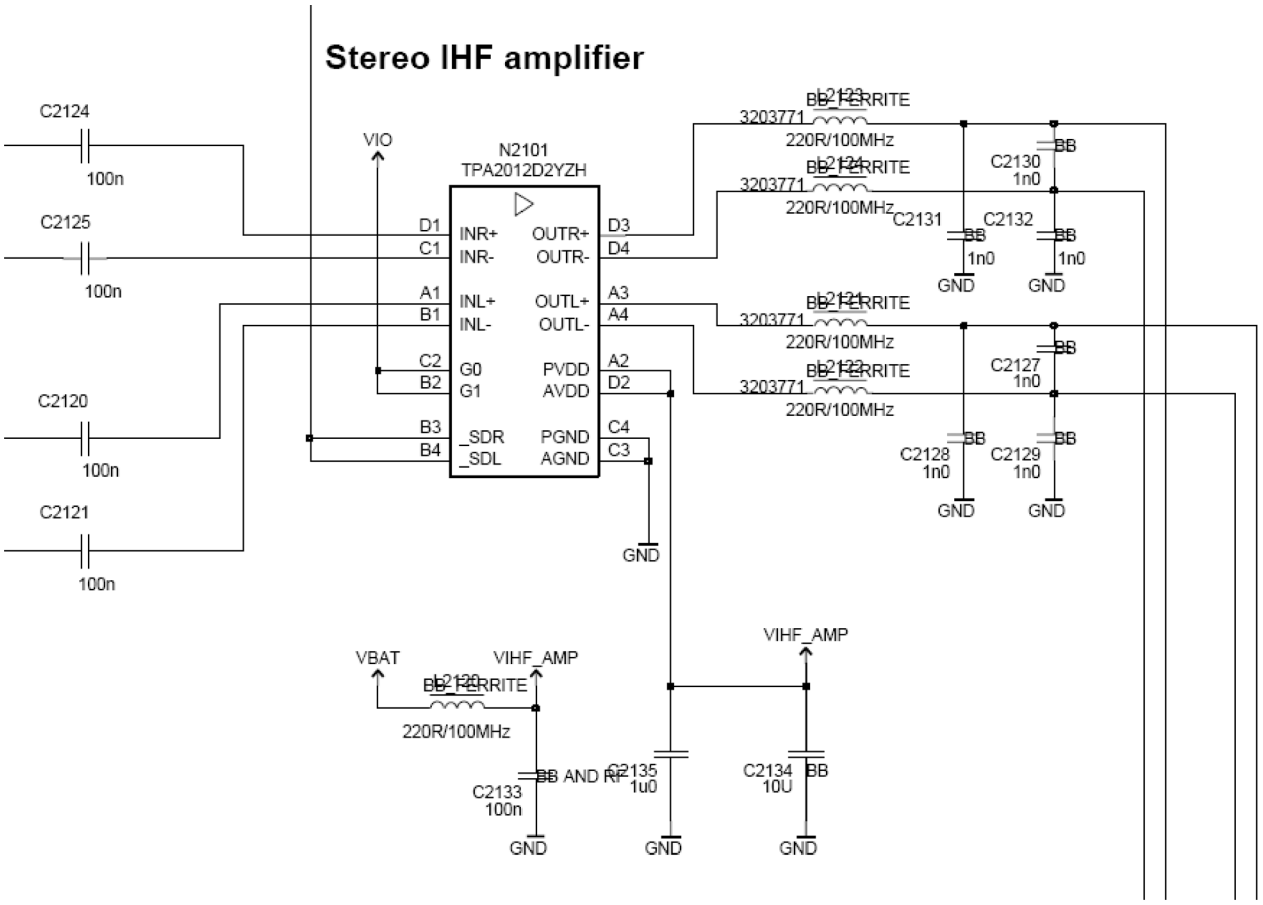


**Figure 102 Internal handsfree speaker amplifier circuitry**

## System connector

The system connector provides a fully differential 4–wire stereo line-level output connection and a fully differential 2-wire mono line-level or microphone level input connection.

The handsfree driver in one of the EM ASICs is meant for the headset.

The output is driven in a fully differential mode. In the fully differential mode, the handsfree pin is the negative output and the HFCM pin is the positive output. The gain of the handsfree driver in the differential mode is 6 dB.


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The earpiece and headset signals are multiplexed so that the outputs cannot be used simultaneously.

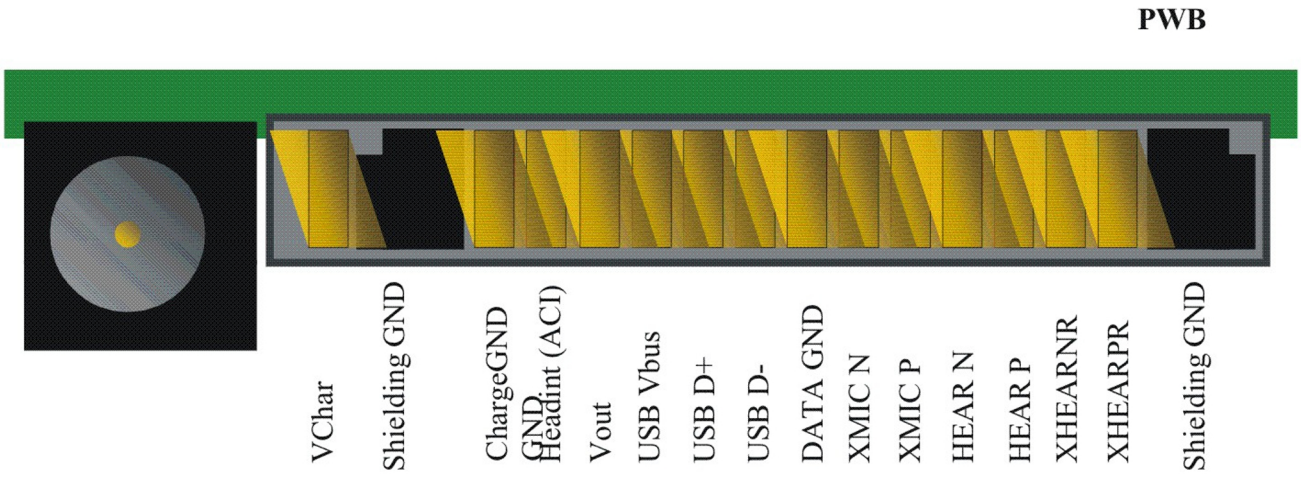


**Figure 103 External audio connector**

**Table 21 Audio connector pin assignments**

| Pin #/ Signal name | Signal description | Spectral range | Voltage/ Current levels | Max or nominal serial impedance | Notes |
|---|---|---|---|---|---|
| 1/ Charge | V Charge | DC | 0-9V/ 0.85A | | |
| 2/ GND | Charge GND | - | 0.85A | 100mΩ (PWB+ conn.) | |
| 3/ ACI | ACI | 1kbits/s | Digital 0 / 2.5-2.78V | 47Ω | Insertion & removal detection |
| 4/ Vout | DC out | DC | 2.78V 70 mA / 2.5V 90mA | 100mΩ (PWB+ conn.) | 200mW |
| 9 / XMIC N | Audio in | 300-8k | 1Vpp & 2.5-2.78VDC | | |
| 10 / XMIC P | Audio in | 300-8k | 1Vpp & 2.5-2.78VDC | | |
| 11 / HEAR N | Audio out | 20-20k | 1Vpp | 10Ω | |
| 12 / HEAR P | Audio out | 20-20k | 1Vpp | 10Ω | |
| 13 / HEAR R N | Audio out | 20-20k | 1Vpp | 10Ω | Not conn. in mono |
| 14 / HEAR R P | Audio out | 20-20k | 1Vpp | 10Ω | Not conn. in mono |


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# Baseband technical specifications

## External interfaces

### *List of external interfaces*

| Name of Connection | Connector reference |
|---|---|
| USB | X2001 |
| Charger | X2000 |
| Headset | X2001 |
| SIM | X2700 |
| MiniSD | X9300 |
| Battery connector | X2070 |

### *ACI interface electrical characteristics*

| Description | Parameter | Min | Typ | Max | Unit | Notes |
|---|---|---|---|---|---|---|
| **Accessory detection** | | | | | | |
| Headset detection threshold | | 1.75 | 1.9 | 2.05 | V | N2200 specific |
| Headset detection hysteresis | | | 25 | | mV | |
| Headset detection pull ups | | 1 | 2 | 4 | uA | |
| **After Mbus is switched to HeadDet** | | | | | | |
| High-level input voltage (VDDS = 1.8V) | $V_{IH}$ | 0.7 x $V_{DDS}$ | | $V_{DDS}$ | V | RAP specific |
| Low-level input voltage | $V_{IL}$ | 0 | | 0.3 x $V_{DDS}$ | V | |
| High-level output voltage | $V_{OH}$ | 0.8 x $V_{DDS}$ | | $V_{DDS}$ | V | |
| Low-level output voltage | $V_{OL}$ | 0 | | 0.22 x VDDS | V | |
| Rise/fall time | tR/tF | | | 25 | ns | |

### *VOUT electrical characteristics*

| Description | Parameter | Min | Max | Typical | Unit | Notes |
|---|---|---|---|---|---|---|
| Vout regulator for external accessories | VOUT | 2.43 | 2.57 | 2.5 | V | Max load 90mA |


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## *USB IF electrical characteristics*

| Description | Parameter | Min | Max | Unit | Notes |
|---|---|---|---|---|---|
| Absolute maximum voltage on D+ and D- | $V_{D+/D-}$ | -1 | 4.6 | V | USB specification revision 2.0 |
| Supply voltage | VBUS | 4.4 | 5.25 | V | |
| Supply current: | | | | | |
| Functioning | $I_{VBUS}$ | | 100 | mA | |
| Suspended | $I_{VBUS}$ | | 500 | uA | |
| Unconfigured | $I_{VBUS}$ | | 100 | mA | |
| High-level input voltage: | | | | V | |
| High (driven) | $V_{IH}$ | 2 | | | |
| High (floating) | $V_{IHZ}$ | 2.7 | 3.6 | | |
| Low-level input voltage | $V_{IL}$ | | 0.8 | V | |
| Differential input sensitivity | $V_{DI}$ | 0.2 | | V | \|(D+) - (D-)\| |
| Differential input voltage range | $V_{CM}$ | 0.8 | 2.5 | V | Included VDI range |
| Low-level output voltage | $V_{OL}$ | 0 | 0.3 | V | |
| High-level output voltage (driven) | $V_{OH}$ | 2.8 | 3.6 | V | |
| Output signal crossover voltage | $V_{CRS}$ | 1.3 | 2 | V | |

## *FBUS interface electrical characteristics (between RAP and N2300)*

| Description | Parameter | Min | Max | Unit |
|---|---|---|---|---|
| High-level input voltage | $V_{IH}$ | 0.7 x $V_{DDSHV2}$ | $V_{DDSHV2}$ | V |
| Low-level Input voltage | $V_{IL}$ | 0 | 0.3 x $V_{DDSHV2}$ | V |
| High-level output voltage | $V_{OH}$ | 0.8 x $V_{DDSHV2}$ | $V_{DDSHV2}$ | V |
| Low-level output voltage | $V_{OL}$ | 0 | 0.22 x $V_{DDSHV2}$ | V |
| Rise/fall time | tR/tF | 0 | 25 | ns |
| (VDDSHV2 = 1.8V) | | | | |


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## Headset hook detection interface (XMICN) electrical characteristics

| Description | Min | Typ | Max | Unit | Notes |
|---|---|---|---|---|---|
| Hook detection threshold 1 | 1.25 | 1.35 | 1.45 | V | Two fixed thresholds inside N2200. Selectable by SW |
| Hook detection threshold 2 | 0.5 | 0.6 | 0.7 | V | |
| Hook detection hysteresis | | 25 | | mV | |
| Hook detection pull ups | 1 | 2 | 4 | uA | |

## Audio signal electrical characteristics

| Description | Parameter | Typ | Unit | Notes |
|---|---|---|---|---|
| XMIC N | Audio in | 1 | $V_{pp}$ | DC Offset 2.5-2.78V |
| XMIC P | Audio in | 1 | $V_{pp}$ | DC Offset 2.5-2.78V |
| HSEAR N | Audio out | 1 | $V_{pp}$ | 10Ω nominal serial impedance |
| HSEAR P | Audio out | 1 | $V_{pp}$ | 10Ω nominal serial impedance |
| HSEAR R N | Audio out | 1 | $V_{pp}$ | 10Ω nominal serial impedance |
| | | | | Not connected in mono |
| HSEAR R P | Audio out | 1 | $V_{pp}$ | 10Ω nominal serial impedance |
| | | | | Not connected in mono |

## SIM IF connections

| Pin | Signal | I/O | Engine connection | | Notes |
|---|---|---|---|---|---|
| C1 | VSIM | Out | EM ASIC N2200 | VSIM1 | Supply voltage to SIM card, 1.8V or 3.0V. |
| C2 | SIMRST | Out | EM ASIC N2200 | SIM1Rst | Reset signal to SIM card |
| C3 | SIMCLK | Out | EM ASIC N2200 | SIM1ClkC | Clock signal to SIM card |
| C5 | GND | - | GND | | Ground |


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| Pin | Signal | I/O | Engine connection | | Notes |
|---|---|---|---|---|---|
| C7 | SIMDATA | In/Out | EM ASIC N2200 | SIM1DaC | Data input / output |
| SW | SIM_DET | In | EM ASIC N2200 | SIMDetX | Removal detection |

## *Charger connector and charging interface connections & electrical characteristics*

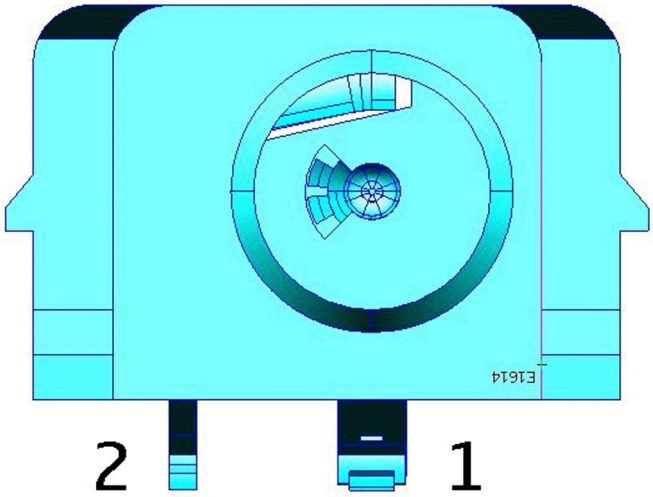


**Figure 104 Charger connector**

**Table 22 Charging interface connections**

| Pin | Signal | I/O | Engine connection | | Notes |
|---|---|---|---|---|---|
| 1 | Vchar | In | N2300 | VCharIn1, 2 | Charging voltage / charger detection, Center pin |
| 2 | Charge GND | | Ground | | Charger ground |

**Table 23 Charging IF electrical characteristics**

| Description | Parameter | Min | Max | Unit | Notes |
|---|---|---|---|---|---|
| Vchar | V Charge | 0 | 9 | V | Center pin |
| Vchar | I Charge | | 0.85 | A | Center pin |
| Charge GND | | | 0.85 | A | |


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### *Battery connector and interface connections & electrical characteristics*

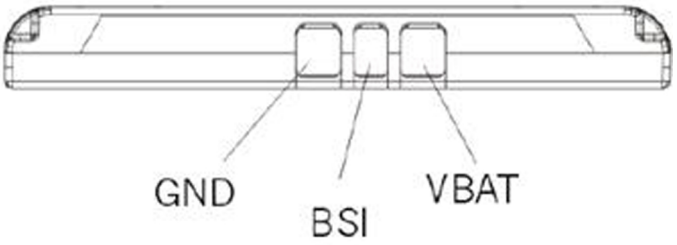


**Figure 105 Battery connector**

**Table 24 Battery interface connections**

| Pin | Signal | I/O | Engine connection | | Notes |
|---|---|---|---|---|---|
| 1 | VBAT | -> | EM ASIC N2200 | VBAT | Battery voltage |
| 2 | BSI | -> | EM ASIC N2200 | BSI | Battery size indication (fixed resistor inside the battery pack) |
| 3 | GND | | GND | | Ground |

**Table 25 Battery IF electrical characteristics**

| Description | Parameter | Max | Unit |
|---|---|---|---|
| Operation voltage | $V_{IN}$ | 4.23 | VDC |
| Current rating | $I_{IN}$ | 0.9 | A |

## Internal interfaces

### *Internal interfaces*

| Name of connection | Connector reference |
|---|---|
| **Bottom module board** | |
| Microcoaxial connector to top block | X4401 |
| Microcoaxial connector to top block | X4402 |
| Microcoaxial connector to main camera | X4400 |
| Flex connector to volume keys and flash LED | X4403 |
| Charger connector | X2000 |
| System connector | X2001 |
| Battery connector | X2070 |
| SIM connector | X2700 |


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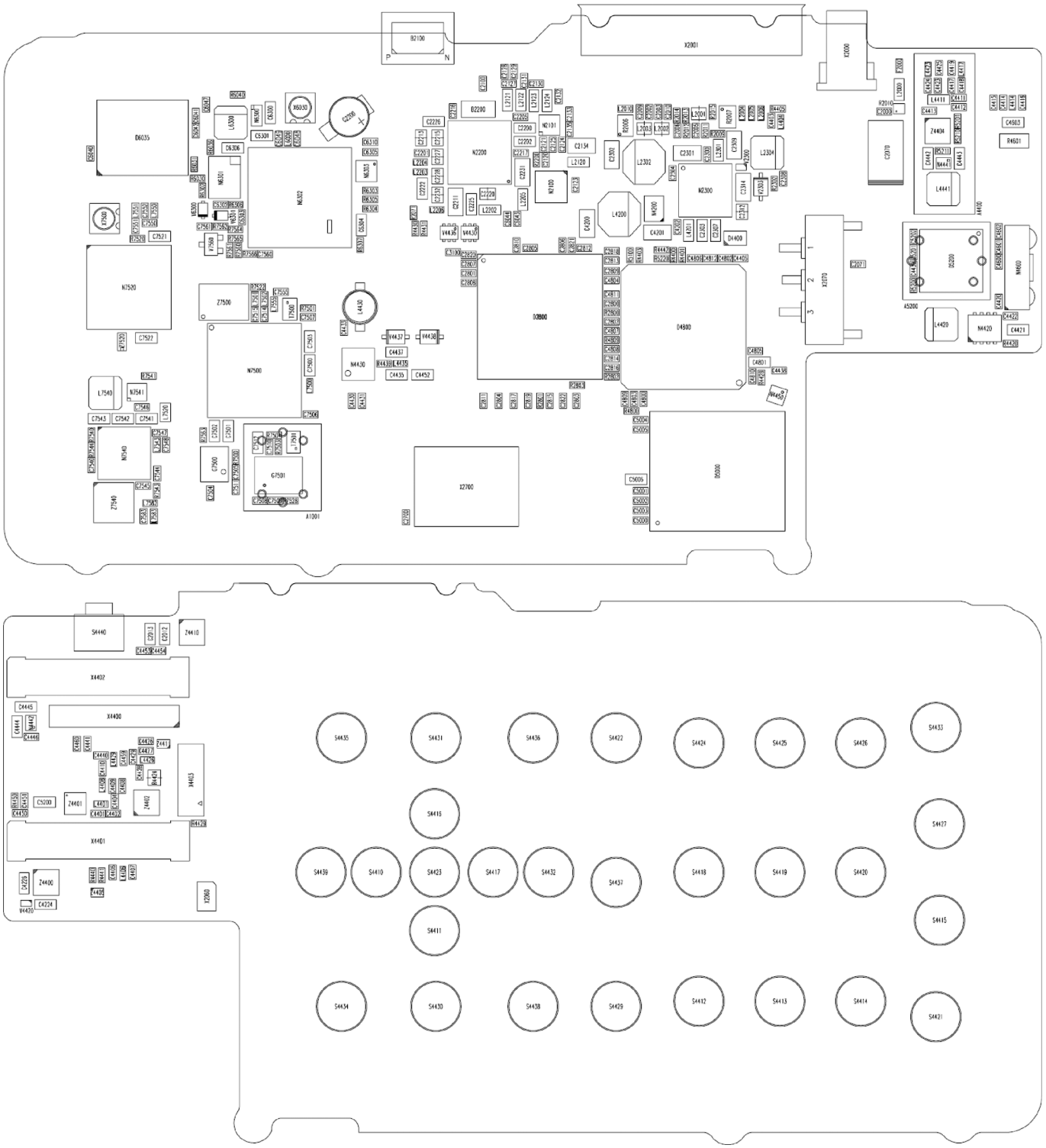
| Name of connection | Connector reference |
|---|---|
| Microphone interface connection | B2100 |



| Name of connection | Connector reference |
|---|---|
| **Top module board** | |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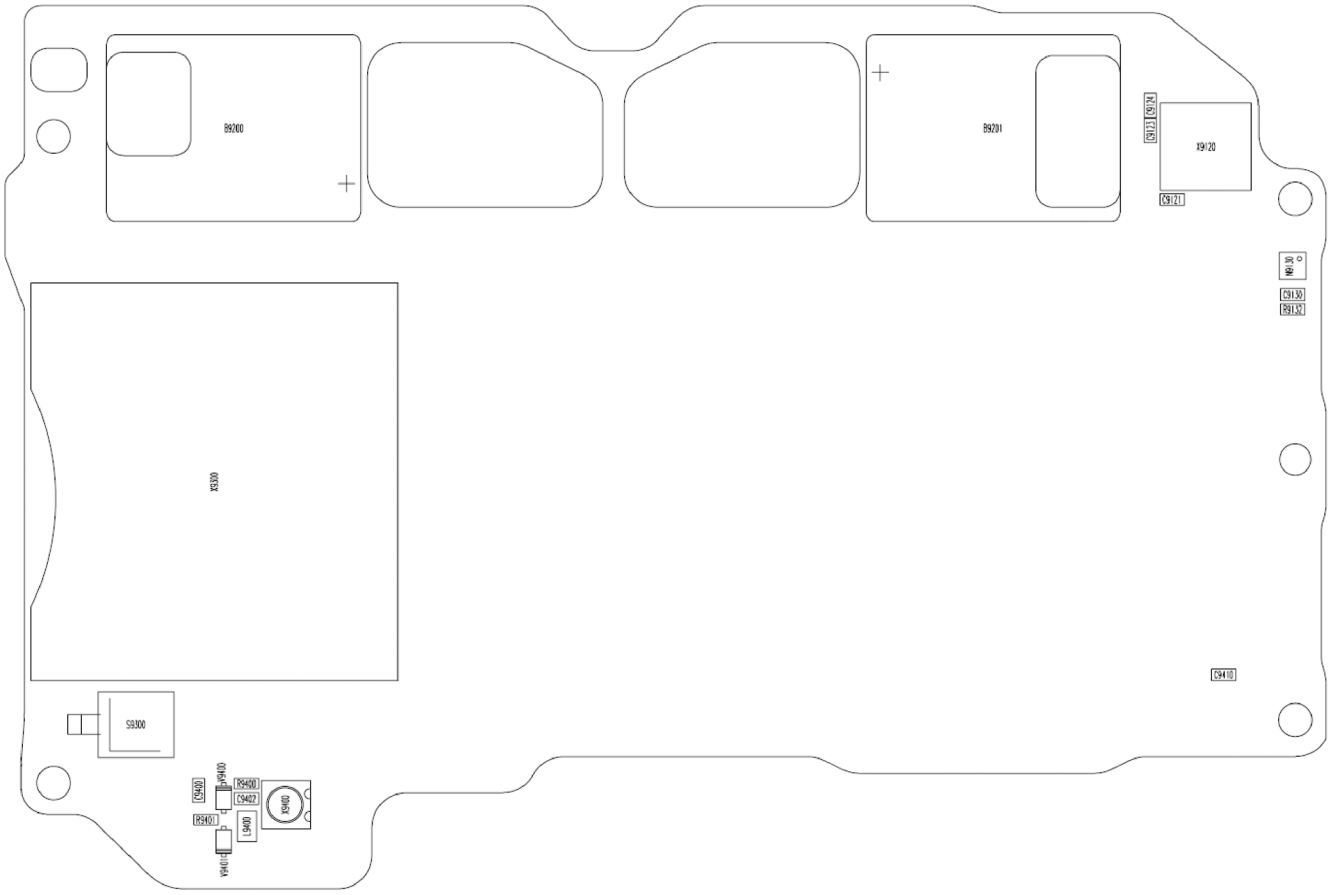
| Name of connection | Connector reference |
|---|---|
| Microcoaxial connector to bottom block | X9000 |
| Microcoaxial connector to bottom block | X9001 |
| Flex connector for earpiece and power key | X9200 |
| Mini SD card reader | X9300 |
| Main display connector | X9100 |
| Sub display connector | X9120 |





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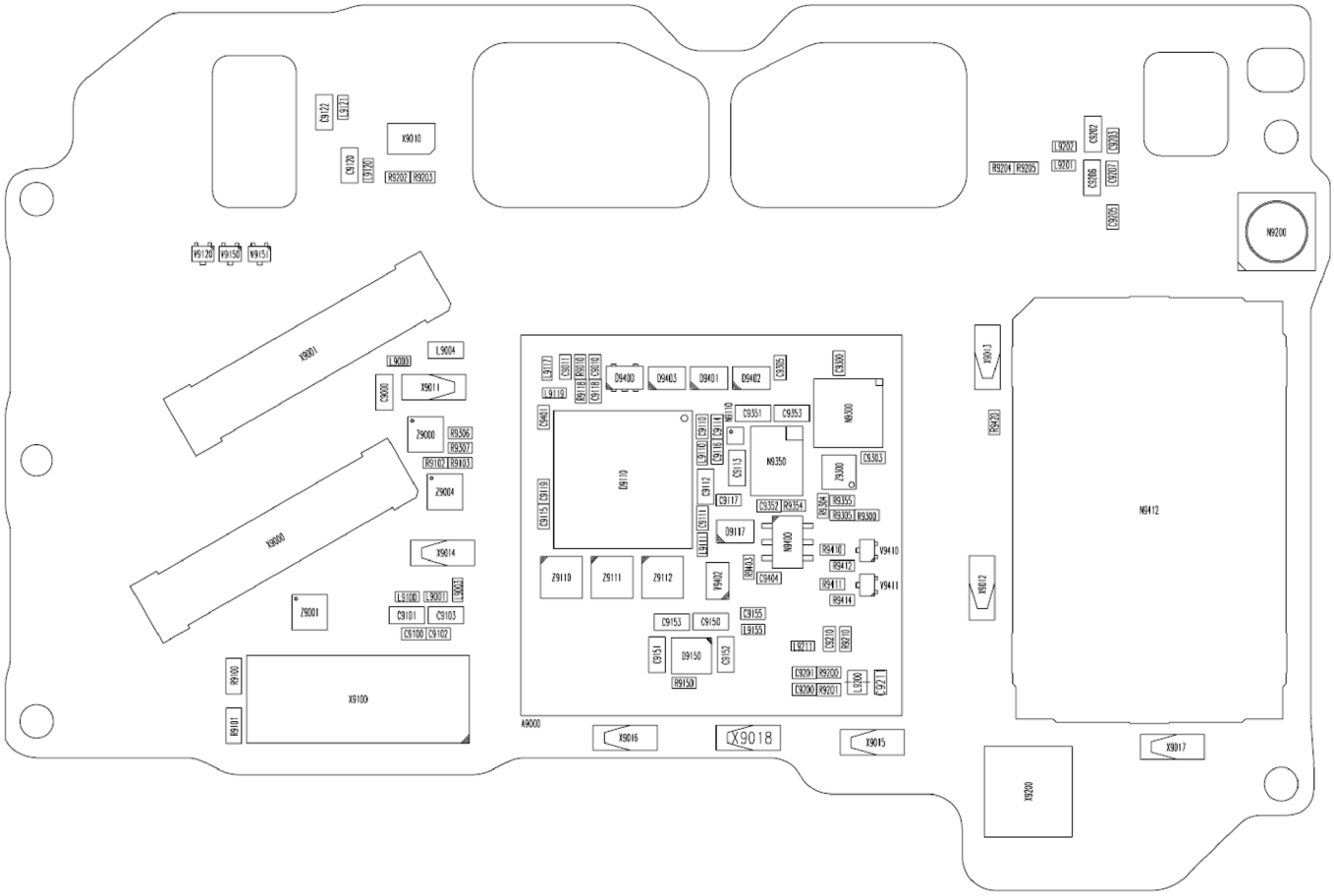

## Bottom and top block interface

**Table 26 X4401 <-> X9000 connections**

| Number | Function | Direction | Engine connection | |
|---|---|---|---|---|
| 1 | SPI DIN | <- | APE SPI | SPI(1) |
| 2 | SPI DOUT | -> | APE SPI | SPI(2) |
| 3 | NCS0_DVB_H | -> | APE SPI | SPI(3) |
| 4 | SPI CLK | -> | APE SPI | SPI(0) |
| 5 | ENABLE | -> | APE GPIO | DVBH(4) |
| 6 | IRQ | -> | APE GPIO | DVBH(5) |
| 7 | ACTIVITY | -> | APE GPIO | DVBH(0) |
| 8 | NCS3_PISA | -> | APE SPI | SPI(6) |
| 9 | NCS2_HAFER | -> | APE SPI | SPI(4) |
| 10 | Clk | -> | APE MMC | MMC(0) |
| 11 | Cmd | -> | APE MMC | MMC(1) |
| 12 | Dat0 | <-> | APE MMC | MMC(2) |
| 13 | Dat1 | <-> | APE MMC | MMC(3) |
| 14 | Dat2 | <-> | APE MMC | MMC(4) |


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| Number | Function | Direction | Engine connection | |
|---|---|---|---|---|
| 15 | Dat3 | <-> | APE MMC | MMC(5) |
| 16 | Cmddir | | APE MMC | MMC(6) |
| 17 | Datdir | | APE MMC | MMC(7) |
| 18 | Datdir1 | | APE MMC | MMC(8) |
| 19 | Pwr_ena | -> | APE GPIO | MMC(14) |
| 20 | Push push sw | <- | APE GPIO | MMC(13) |
| 21 | Clkin | <- | APE MMC | MMC(10) |
| 22 | Door sw | <- | APE GPIO | MMC(15) |
| 23 | Vledout | -> | N2200 | Power supply |
| 24 | Setcurr | <- | N2200 | Power supply |
| 25 | Vaux | -> | N2200 | Power supply |
| 26 | Vaux | -> | N2200 | Power supply |
| 27 | Lcdda0 | <-> | APE MeSSI video | MeSSi_Video_APE(0) |
| 28 | Lcdda1 | <-> | APE MeSSI video | MeSSi_Video_APE(1) |
| 29 | Lcdda2 | <-> | APE MeSSI video | MeSSi_Video_APE(2) |
| 30 | Lcdda3 | <-> | APE MeSSI video | MeSSi_Video_APE(3) |
| 31 | Lcdda4 | <-> | APE MeSSI video | MeSSi_Video_APE(4) |
| 32 | Lcdda5 | <-> | APE MeSSI video | MeSSi_Video_APE(5) |
| 33 | Lcdda6 | <-> | APE MeSSI video | MeSSi_Video_APE(6) |
| 34 | Lcdda7 | <-> | APE MeSSI video | MeSSi_Video_APE(7) |
| 35 | Lcdcsx | -> | APE MeSSI video | MeSSi_Video_APE(8) |
| 36 | Lcdwrx | -> | APE MeSSI video | MeSSi_Video_APE(9) |
| 37 | Lcdrdx | -> | APE MeSSI video | MeSSi_Video_APE (10) |
| 38 | Lcdcmd | -> | APE MeSSI video | MeSSi_Video_APE (11) |
| 39 | Gpio60 | -> | APE GPIO (display reset) | MeSSi_Video_APE (12) |
| 40 | Te | <- | APE MeSSI video | MeSSi_Video_APE (13) |

**Table 27 X4402 <-> X9001 connections**

| Number | Function | Direction | Engine connection | |
|---|---|---|---|---|
| 1 | VBATT | -> | Battery | Power supply |
| 2 | VBATT | -> | Battery | Power supply |


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| Number | Function | Direction | Engine connection | |
|---|---|---|---|---|
| 3 | VBATT | -> | Battery | Power supply |
| 4 | VBATT | -> | Battery | Power supply |
| 5 | VIO | -> | N2300 | Power supply |
| 6 | VIO | -> | N2300 | Power supply |
| 7 | GND | | GND | |
| 8 | GND | | GND | |
| 9 | GND | | GND | |
| 10 | GND | | GND | |
| 11 | GND | | GND | |
| 12 | GND | | GND | |
| 13 | Cam2_reset | -> | HWA GPIO | |
| 14 | Clk | -> | APE GPIO | CAM_CTRL(0) |
| 15 | GND | | GND | |
| 16 | Dap | <- | HWA CCP2 | CCP_HWA_CAM_600 MHz(6) |
| 17 | Clkp | <- | HWA CCP2 | CCP_HWA_CAM_600 MHz (4) |
| 18 | Dan | <- | HWA CCP2 | CCP_HWA_CAM_600 MHz (7) |
| 19 | Clkn | <- | HWA CCP2 | CCP_HWA_CAM_600 MHz (5) |
| 20 | SDA | <-> | HWA CCI | CAM_CTRL(3) |
| 21 | SCL | -> | HWA CCI | CAM_CTRL(4) |
| 22 | VCAM28 | -> | N4442 | Power supply |
| 23 | VCAM28 | -> | N4442 | Power supply |
| 24 | VCAM18 | -> | N4441 | Power supply |
| 25 | VCAM18 | -> | N4441 | Power supply |
| 26 | HFSPRP | -> | N2101 | ST_IHF_HS(2) |
| 27 | HFSPRP | -> | N2101 | ST_IHF_HS(2) |
| 28 | HFSPRN | -> | N2101 | ST_IHF_HS(3) |
| 29 | HFSPRN | -> | N2101 | ST_IHF_HS(3) |
| 30 | HFSPN | -> | N2101 | ST_IHF_HS(0) |
| 31 | HFSPN | -> | N2101 | ST_IHF_HS(0) |
| 32 | HFSPP | -> | N2101 | ST_IHF_HS(1) |
| 33 | HFSPP | -> | N2101 | ST_IHF_HS(1) |
| 34 | EARP | -> | N2300 | AUDIO(0) |


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| Number | Function | Direction | Engine connection | |
|---|---|---|---|---|
| 35 | EARN | -> | N2300 | AUDIO(1) |
| 36 | Position_sensor | <- | APE GPIO | HALLSENSOR(0) |
| 37 | Pisa_bl_enable | -> | APE GPIO | LEDCTRL(0) |
| 38 | PWRONX | <- | N2300 | PWRONX |
| 39 | GND | | GND | |
| 40 | Display_clk | -> | APE system clock | PUSL(6) |

## Bottom block and main camera interface

**Table 28 X4400 <-> main camera**

| Number | Function | Direction | Camera socket | Engine connection | |
|---|---|---|---|---|---|
| 1 | GND | | Camera PWB GND | GND | |
| 2 | VCAM18 | -> | 12 | N4441 | Power supply |
| 3 | VCAM18 | -> | 12 | N4441 | Power supply |
| 4 | VCAM18 | -> | 12 | N4441 | Power supply |
| 5 | VCAM28 | -> | 4 | N4442 | Power supply |
| 6 | VCAM28 | -> | 4 | N4442 | Power supply |
| 7 | GND | -> | Camera PWB GND | GND | |
| 8 | Dan | -> | 13 | HWA CCP | CCP_HWA_CAM_600MHz(3) |
| 9 | Dap | -> | 14 | HWA CCP | CCP_HWA_CAM_600MHz(2) |
| 10 | GND | -> | Camera PWB GND | GND | |
| 11 | Clkp | -> | 11 | HWA CCP | CCP_HWA_CAM_600MHz(0) |
| 12 | Clkn | <-> | 10 | HWA CCP | CCP_HWA_CAM_600MHz(1) |
| 13 | GND | <-> | Camera PWB GND | GND | |
| 14 | Sda | <-> | 8 | HWA CCI | CAM_CTRL(3) |
| 15 | Scl | <-> | 7 | HWA CCI | CAM_CTRL(4) |
| 16 | GND | | Camera PWB GND | GND | |
| 17 | Clk | | 6 | APE GPIO | CAM_CTRL(0) |
| 18 | GND | | Camera PWB GND | GND | |
| 19 | Reset | -> | 5 | HWA GPIO | |
| 20 | GND | <- | Camera PWB GND | GND | CAM_CTRL(2) |


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### *Back-up battery interface electrical characteristics*

**Table 29 Back-up battery connections**

| Pin name | I/O | Connection | Notes |
|---|---|---|---|
| G2200, VBack | -> | N2200, VBack | Back-up battery G2200 is connected to N2200 |

**Table 30 Back-up battery electrical characteristics**

| Description | Parameter | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Back-Up Battery Voltage | Vback | 0 | 2.5 | 2.7 | V |

## RF description

### RF introduction

The RF is controlled by digital baseband circuitry via a serial bus (RFBus). The RFBus is for mode selection, frequency synthesizer control, RX AGC setting, RF regulator control, TX power control loop and PA bias control. In addition to RFBus there are also several other interface signals coming from BB. TX power control (TXC), VCTCXO frequency control (AFC) and some other control signals (voltage and current references, WCDMA TX power detection, PA combination detection).

### Regulators

All RF regulators, except one, are located in the EM ASIC N2200 in the baseband section or in the RF ASIC of the device. The discreet regulator, N7541, feeds the WCDMA PA. The EM ASIC N2200 has three regulators for RF:

- 2.5 V regulator VXO
- 4.75 V regulator VCP (VCP1 & VCP2)
- 1.35 V regulator, VB_EXT, which is the reference voltage.


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## Block diagrams

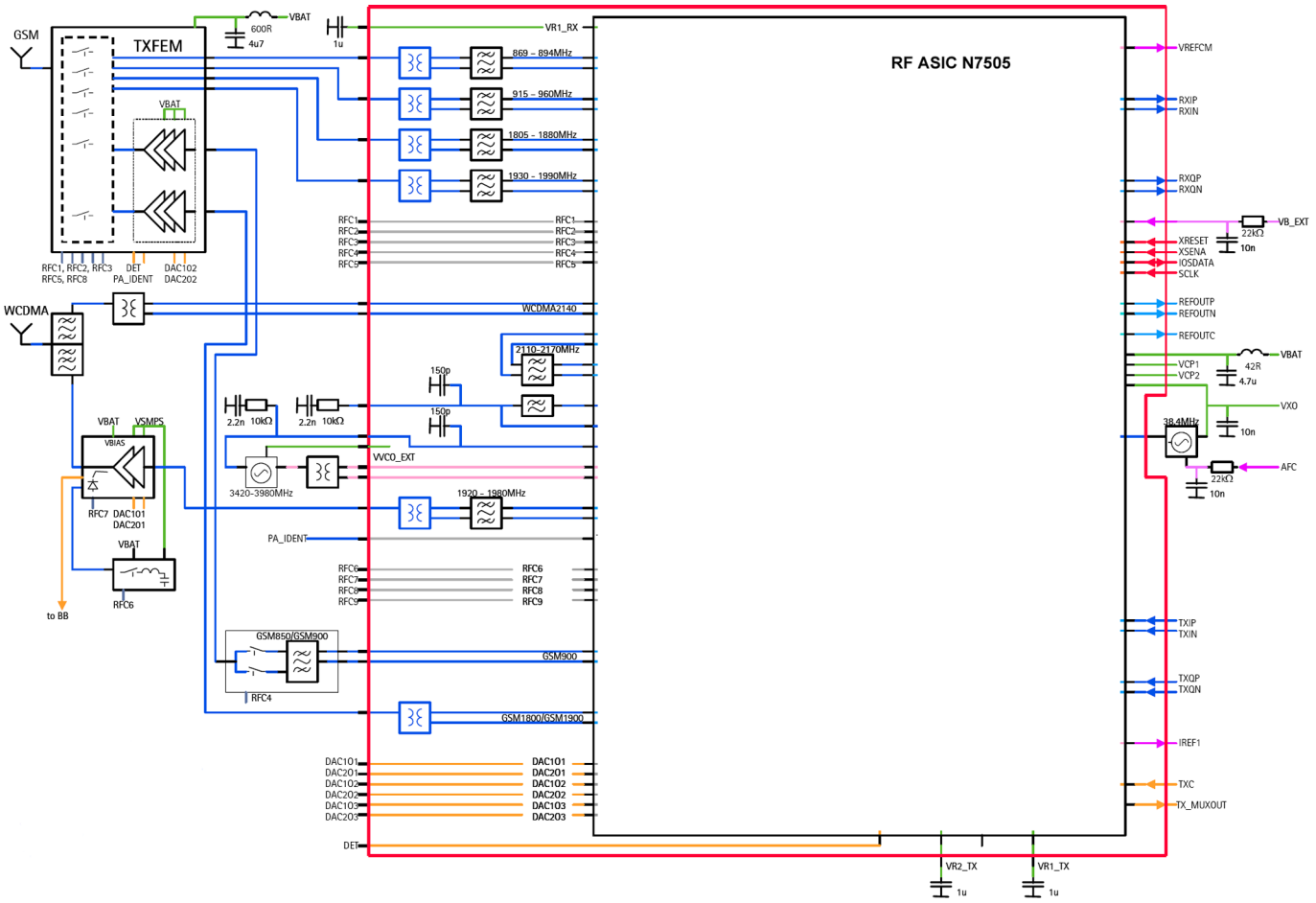


**Figure 106 RF block diagram RM-100 using RF ASIC N7500**

The RF block diagram for RM-100 uses RF ASIC N7500 as illustrated by the red border in the block diagram. It can be seen that the module contains RF ASIC N7505 and all the baluns and filters, except GSM TX filters and the WCDMA balun.

## Frequency plan

Both, the receiver and the transmitter, are based on direct conversion architecture. The VCOs operate at the channel frequency multiplied by two or four depending on the band of operation. This means that the modulated baseband signals are directly converted up to the transmission frequency and the received RF signals directly down to the baseband frequency.


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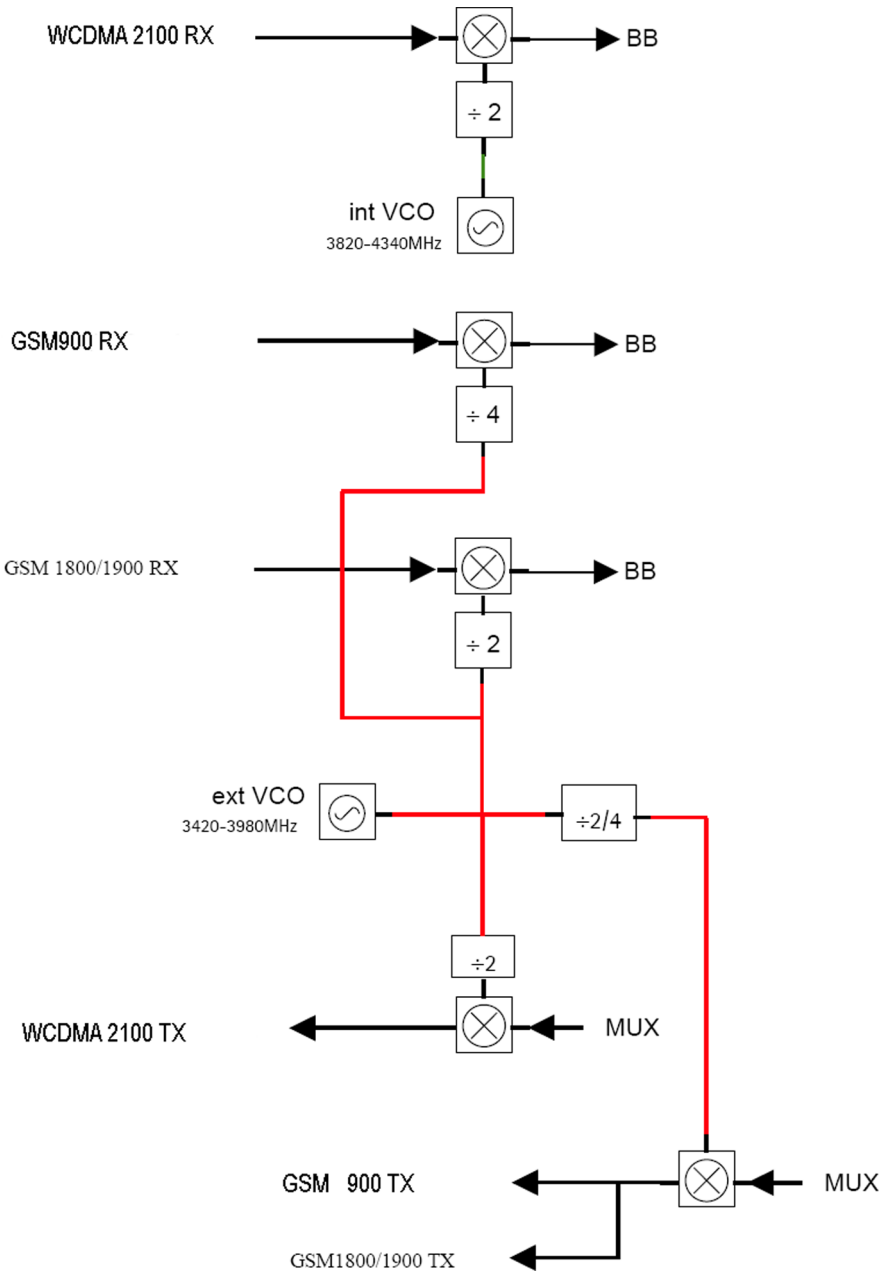


**Figure 107 RF frequency plan**

## Receiver

### *Introduction to receiver functionality*

The receiver is a linear direct conversion receiver containing LNA, band pass filter and demodulator for each supported system and band. After the demodulators the signal paths are combined to one common BB path.

### *WCDMA receiver*

In the WCDMA mode, the received signal is fed from the antenna to the SAW duplex filter. From the duplex filter, the signal goes through a balun to the integrated LNA in the RF ASIC. From the LNA, the signal goes through a band pass filter. After filtering, the signal goes to the down conversion mixer, which converts the signal into baseband I and Q signals.

At BB frequency the signal is amplified and fed to a low pass filters.


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The filter is followed by an AGC amplifier with adjustable gain. The signal is further amplified before it is fed to balanced analog IQ output pins. Analogue output pins are accompanied by reference voltage output, which sets the DC level for the AD converter in BB ASIC.

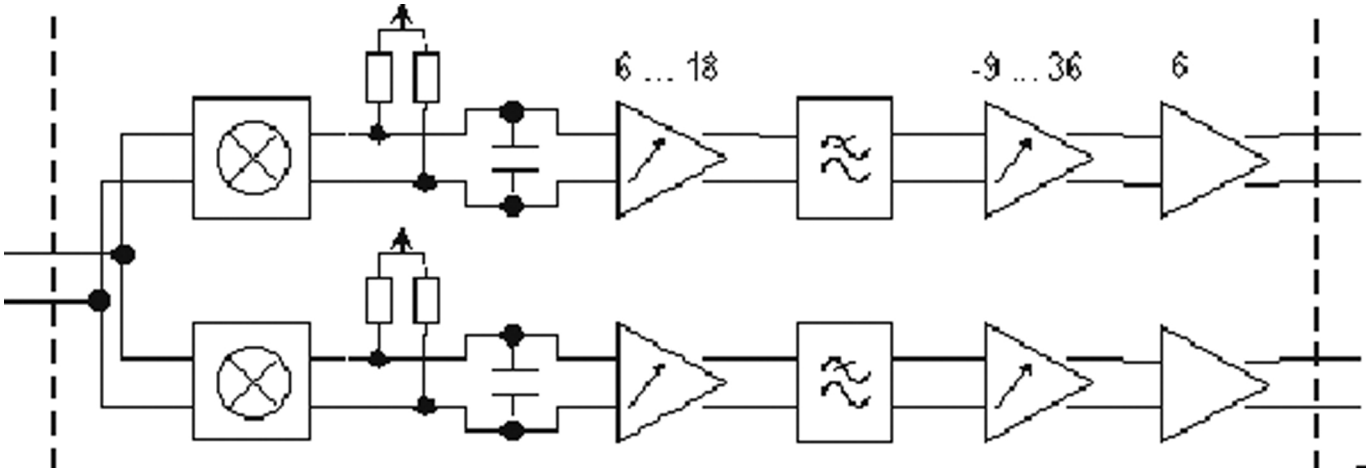


**Figure 108 WCDMA receiver after duplexer, LNA and SAW filter**

### *GSM receiver*

As GSM900, GSM1800 and GSM1900 RX branches are functionally identical, the following description is applicable to all of them.

The received signal goes from the GSM antenna to the antenna switch module. The switch module contains PIN diode switches for band and RX/TX. The antenna switch module is followed by integrated LNA stages in the RF ASIC. The LNAs are followed by demodulators which downconvert the signal to baseband I and Q signals.

In the BB-chain there are two adjustable gain stages and one mode specific gain. The first one called BB-gain is just after the demodulator. It has a 12 dB gain range with 6dB steps. After the BB-gain there is the channel select filter.

Main AGC amplifier proceeds the channel selection filter. It has 30 dB of gain control range with 3 dB steps. Final amplifier stage is used as an output buffer for IQ signals. This stage is set to 0 dB gain in GSM mode.

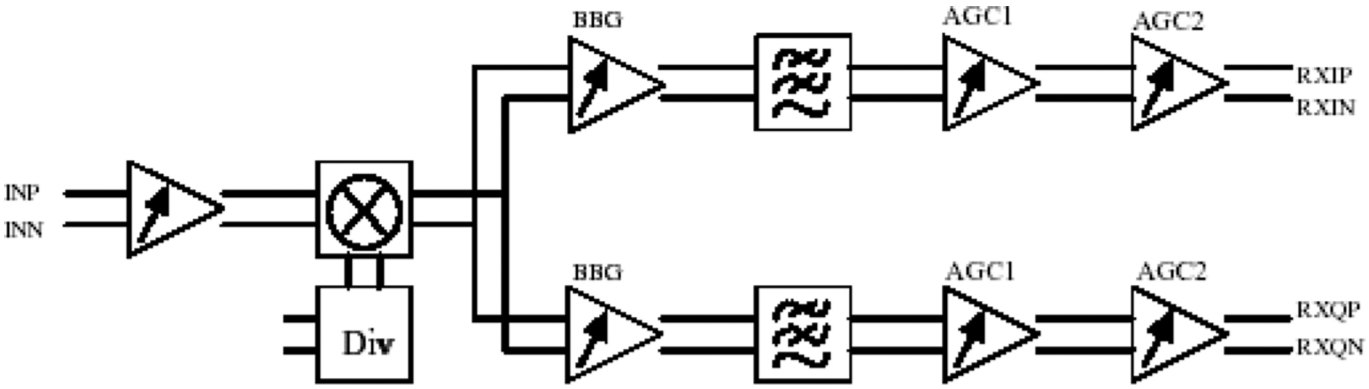


**Figure 109 GSM receiver after the antenna switch**

## Transmitter

### *Introduction to transmitter functionality*

In RM-100, transmitter functions are implemented in the RF ASIC N7500.


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The RF ASICs contain a BB frequency low pass filter, which is tunable according the signal bandwidth of the system in use. In addition, they both contain three separate RF paths (GSM900, GSM1800/1900 and WCDMA) comprising of a final frequency IQ modulator and VGA amplifiers.

### *WCDMA transmitter*

In the transmitter side, an analogue I/Q modulated signal is fed from the digital baseband into the RF ASIC and through the low pass filter. After the filter the signal is fed to the I/Q modulator, which converts the signal to final TX frequency. There are two separate I/Q modulators, one for WCDMA and another for GSM900 and GSM1800/1900 signals. The WCDMA branch is selected by biasing the appropriate modulator. The modulator is followed by two VGA stages. The signal then exits the RF ASIC via a balanced line. The signal is band pass filtered by a SAW filter before it is fed to WCDMA PA module.

After the PA, the transmitted WCDMA signal is fed through the duplex filter to the antenna.

## WCDMA power control

WCDMA TX power control is performed by the two VGA stages in the RF ASIC.

The gain of VGA amplifier chain is controlled by a DA converter in BB. The same DA converter is shared by GSM TX power control function.

## WCDMA PA module

WCDMA PA is housed in a separate module having a variable supply voltage input for the amplifier stages (Vcc11), a battery supply voltage for the bias circuits (Vcc12) and one bias current input. Bias current is generated by 5 bit DA (DAC201) converter in RF ASIC N7500. The converter is controlled via RFBus.

In production the PA quiescent current can be tuned to target value by adjusting the bias current of PA output stage. The bias current is also used as PA on/off controls.

## PA DCDC converter

The DCDC converter is controlled by 5 bit DA (DAC101) converter in RF ASIC N7500. The converter is controlled via RFBus. The DCDC converter limits the lowest supply voltage to 1.3 V. At the highest power levels, the DCDC converter output settles nominally to 3.1 V.

### *GSM transmitter*

An analog IQ modulated signal is fed to the RF ASIC from Digital BB. It is first low pass filtered then routed to the GSM modulator. The appropriate routing after the modulator is selected by biasing either GSM900 or GSM1800/1900 variable gain amplifier.

After the VGA stage, the signal exits the RF ASIC. In case of GSM1800/1900, the signal goes directly to the GSM PA module. In case of GSM900, the PA module is preceded by a switchable SAW filter Z7500. After the filter, the signal is fed to GSM TX front-end module (TXFEM N7520), which also contains the antenna switch. Between TXFEM and antenna is discrete DVB-H band noise filter.

## GSM PA module

The TXFEM module contains two separate amplifier chains, one for GSM900 and another for GSM1800/1900. Both amplifiers have a battery supply connection and two bias current inputs.

### Frequency synthesizers

There are two separate synthesizers for WCDMA Rx and WCDMA Tx / GSM Tx / Rx. This allows the duplex separation to be set according the network settings in the WCDMA mode.

The VCOs are locked by PLLs into a reference oscillator, VCTCXO (Voltage Controlled Temperature Compensated Crystal Oscillator).

The PLLs are located in RF ASICs and controlled via RFBus.


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## Reference oscillator

A 38.4MHz VCTCXO is used as a reference oscillator for the frequency synthesizers.

The frequency of the reference oscillator is locked into the frequency of the base station with the help of an AFC voltage, which is generated in BB by DSP and converted by dedicated DAC.


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## Frequency mappings

### EGSM900 frequencies

| CH | TX | RX | VCO TX | VCO RX | CH | TX | RX | VCO TX | VCO RX | CH | TX | RX | VCO TX | VCO RX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 975 | 880,2 | 925,2 | 3520,8 | 3700,8 | 1 | 890,2 | 935,2 | 3560,8 | 3740,8 | 63 | 902,6 | 947,6 | 3610,4 | 3790,4 |
| 976 | 880,4 | 925,4 | 3521,6 | 3701,6 | 2 | 890,4 | 935,4 | 3561,6 | 3741,6 | 64 | 902,8 | 947,8 | 3611,2 | 3791,2 |
| 977 | 880,6 | 925,6 | 3522,4 | 3702,4 | 3 | 890,6 | 935,6 | 3562,4 | 3742,4 | 65 | 903,0 | 948,0 | 3612,0 | 3792,0 |
| 978 | 880,8 | 925,8 | 3523,2 | 3703,2 | 4 | 890,8 | 935,8 | 3563,2 | 3743,2 | 66 | 903,2 | 948,2 | 3612,8 | 3792,8 |
| 979 | 881,0 | 926,0 | 3524,0 | 3704,0 | 5 | 891,0 | 936,0 | 3564,0 | 3744,0 | 67 | 903,4 | 948,4 | 3613,6 | 3793,6 |
| 980 | 881,2 | 926,2 | 3524,8 | 3704,8 | 6 | 891,2 | 936,2 | 3564,8 | 3744,8 | 68 | 903,6 | 948,6 | 3614,4 | 3794,4 |
| 981 | 881,4 | 926,4 | 3525,6 | 3705,6 | 7 | 891,4 | 936,4 | 3565,6 | 3745,6 | 69 | 903,8 | 948,8 | 3615,2 | 3795,2 |
| 982 | 881,6 | 926,6 | 3526,4 | 3706,4 | 8 | 891,6 | 936,6 | 3566,4 | 3746,4 | 70 | 904,0 | 949,0 | 3616,0 | 3796,0 |
| 983 | 881,8 | 926,8 | 3527,2 | 3707,2 | 9 | 891,8 | 936,8 | 3567,2 | 3747,2 | 71 | 904,2 | 949,2 | 3616,8 | 3796,8 |
| 984 | 882,0 | 927,0 | 3528,0 | 3708,0 | 10 | 892,0 | 937,0 | 3568,0 | 3748,0 | 72 | 904,4 | 949,4 | 3617,6 | 3797,6 |
| 985 | 882,2 | 927,2 | 3528,8 | 3708,8 | 11 | 892,2 | 937,2 | 3568,8 | 3748,8 | 73 | 904,6 | 949,6 | 3618,4 | 3798,4 |
| 986 | 882,4 | 927,4 | 3529,6 | 3709,6 | 12 | 892,4 | 937,4 | 3569,6 | 3749,6 | 74 | 904,8 | 949,8 | 3619,2 | 3799,2 |
| 987 | 882,6 | 927,6 | 3530,4 | 3710,4 | 13 | 892,6 | 937,6 | 3570,4 | 3750,4 | 75 | 905,0 | 950,0 | 3620,0 | 3800,0 |
| 988 | 882,8 | 927,8 | 3531,2 | 3711,2 | 14 | 892,8 | 937,8 | 3571,2 | 3751,2 | 76 | 905,2 | 950,2 | 3620,8 | 3800,8 |
| 989 | 883,0 | 928,0 | 3532,0 | 3712,0 | 15 | 893,0 | 938,0 | 3572,0 | 3752,0 | 77 | 905,4 | 950,4 | 3621,6 | 3801,6 |
| 990 | 883,2 | 928,2 | 3532,8 | 3712,8 | 16 | 893,2 | 938,2 | 3572,8 | 3752,8 | 78 | 905,6 | 950,6 | 3622,4 | 3802,4 |
| 991 | 883,4 | 928,4 | 3533,6 | 3713,6 | 17 | 893,4 | 938,4 | 3573,6 | 3753,6 | 79 | 905,8 | 950,8 | 3623,2 | 3803,2 |
| 992 | 883,6 | 928,6 | 3534,4 | 3714,4 | 18 | 893,6 | 938,6 | 3574,4 | 3754,4 | 80 | 906,0 | 951,0 | 3624,0 | 3804,0 |
| 993 | 883,8 | 928,8 | 3535,2 | 3715,2 | 19 | 893,8 | 938,8 | 3575,2 | 3755,2 | 81 | 906,2 | 951,2 | 3624,8 | 3804,8 |
| 994 | 884,0 | 929,0 | 3536,0 | 3716,0 | 20 | 894,0 | 939,0 | 3576,0 | 3756,0 | 82 | 906,4 | 951,4 | 3625,6 | 3805,6 |
| 995 | 884,2 | 929,2 | 3536,8 | 3716,8 | 21 | 894,2 | 939,2 | 3576,8 | 3756,8 | 83 | 906,6 | 951,6 | 3626,4 | 3806,4 |
| 996 | 884,4 | 929,4 | 3537,6 | 3717,6 | 22 | 894,4 | 939,4 | 3577,6 | 3757,6 | 84 | 906,8 | 951,8 | 3627,2 | 3807,2 |
| 997 | 884,6 | 929,6 | 3538,4 | 3718,4 | 23 | 894,6 | 939,6 | 3578,4 | 3758,4 | 85 | 907,0 | 952,0 | 3628,0 | 3808,0 |
| 998 | 884,8 | 929,8 | 3539,2 | 3719,2 | 24 | 894,8 | 939,8 | 3579,2 | 3759,2 | 86 | 907,2 | 952,2 | 3628,8 | 3808,8 |
| 999 | 885,0 | 930,0 | 3540,0 | 3720,0 | 25 | 895,0 | 940,0 | 3580,0 | 3760,0 | 87 | 907,4 | 952,4 | 3629,6 | 3809,6 |
| 1000 | 885,2 | 930,2 | 3540,8 | 3720,8 | 26 | 895,2 | 940,2 | 3580,8 | 3760,8 | 88 | 907,6 | 952,6 | 3630,4 | 3810,4 |
| 1001 | 885,4 | 930,4 | 3541,6 | 3721,6 | 27 | 895,4 | 940,4 | 3581,6 | 3761,6 | 89 | 907,8 | 952,8 | 3631,2 | 3811,2 |
| 1002 | 885,6 | 930,6 | 3542,4 | 3722,4 | 28 | 895,6 | 940,6 | 3582,4 | 3762,4 | 90 | 908,0 | 953,0 | 3632,0 | 3812,0 |
| 1003 | 885,8 | 930,8 | 3543,2 | 3723,2 | 29 | 895,8 | 940,8 | 3583,2 | 3763,2 | 91 | 908,2 | 953,2 | 3632,8 | 3812,8 |
| 1004 | 886,0 | 931,0 | 3544,0 | 3724,0 | 30 | 896,0 | 941,0 | 3584,0 | 3764,0 | 92 | 908,4 | 953,4 | 3633,6 | 3813,6 |
| 1005 | 886,2 | 931,2 | 3544,8 | 3724,8 | 31 | 896,2 | 941,2 | 3584,8 | 3764,8 | 93 | 908,6 | 953,6 | 3634,4 | 3814,4 |
| 1006 | 886,4 | 931,4 | 3545,6 | 3725,6 | 32 | 896,4 | 941,4 | 3585,6 | 3765,6 | 94 | 908,8 | 953,8 | 3635,2 | 3815,2 |
| 1007 | 886,6 | 931,6 | 3546,4 | 3726,4 | 33 | 896,6 | 941,6 | 3586,4 | 3766,4 | 95 | 909,0 | 954,0 | 3636,0 | 3816,0 |
| 1008 | 886,8 | 931,8 | 3547,2 | 3727,2 | 34 | 896,8 | 941,8 | 3587,2 | 3767,2 | 96 | 909,2 | 954,2 | 3636,8 | 3816,8 |
| 1009 | 887,0 | 932,0 | 3548,0 | 3728,0 | 35 | 897,0 | 942,0 | 3588,0 | 3768,0 | 97 | 909,4 | 954,4 | 3637,6 | 3817,6 |
| 1010 | 887,2 | 932,2 | 3548,8 | 3728,8 | 36 | 897,2 | 942,2 | 3588,8 | 3768,8 | 98 | 909,6 | 954,6 | 3638,4 | 3818,4 |
| 1011 | 887,4 | 932,4 | 3549,6 | 3729,6 | 37 | 897,4 | 942,4 | 3589,6 | 3769,6 | 99 | 909,8 | 954,8 | 3639,2 | 3819,2 |
| 1012 | 887,6 | 932,6 | 3550,4 | 3730,4 | 38 | 897,6 | 942,6 | 3590,4 | 3770,4 | 100 | 910,0 | 955,0 | 3640,0 | 3820,0 |
| 1013 | 887,8 | 932,8 | 3551,2 | 3731,2 | 39 | 897,8 | 942,8 | 3591,2 | 3771,2 | 101 | 910,2 | 955,2 | 3640,8 | 3820,8 |
| 1014 | 888,0 | 933,0 | 3552,0 | 3732,0 | 40 | 898,0 | 943,0 | 3592,0 | 3772,0 | 102 | 910,4 | 955,4 | 3641,6 | 3821,6 |
| 1015 | 888,2 | 933,2 | 3552,8 | 3732,8 | 41 | 898,2 | 943,2 | 3592,8 | 3772,8 | 103 | 910,6 | 955,6 | 3642,4 | 3822,4 |
| 1016 | 888,4 | 933,4 | 3553,6 | 3733,6 | 42 | 898,4 | 943,4 | 3593,6 | 3773,6 | 104 | 910,8 | 955,8 | 3643,2 | 3823,2 |
| 1017 | 888,6 | 933,6 | 3554,4 | 3734,4 | 43 | 898,6 | 943,6 | 3594,4 | 3774,4 | 105 | 911,0 | 956,0 | 3644,0 | 3824,0 |
| 1018 | 888,8 | 933,8 | 3555,2 | 3735,2 | 44 | 898,8 | 943,8 | 3595,2 | 3775,2 | 106 | 911,2 | 956,2 | 3644,8 | 3824,8 |
| 1019 | 889,0 | 934,0 | 3556,0 | 3736,0 | 45 | 899,0 | 944,0 | 3596,0 | 3776,0 | 107 | 911,4 | 956,4 | 3645,6 | 3825,6 |
| 1020 | 889,2 | 934,2 | 3556,8 | 3736,8 | 46 | 899,2 | 944,2 | 3596,8 | 3776,8 | 108 | 911,6 | 956,6 | 3646,4 | 3826,4 |
| 1021 | 889,4 | 934,4 | 3557,6 | 3737,6 | 47 | 899,4 | 944,4 | 3597,6 | 3777,6 | 109 | 911,8 | 956,8 | 3647,2 | 3827,2 |
| 1022 | 889,6 | 934,6 | 3558,4 | 3738,4 | 48 | 899,6 | 944,6 | 3598,4 | 3778,4 | 110 | 912,0 | 957,0 | 3648,0 | 3828,0 |
| 1023 | 889,8 | 934,8 | 3559,2 | 3739,2 | 49 | 899,8 | 944,8 | 3599,2 | 3779,2 | 111 | 912,2 | 957,2 | 3648,8 | 3828,8 |
| 0 | 890,0 | 935,0 | 3560,0 | 3740,0 | 50 | 900,0 | 945,0 | 3600,0 | 3780,0 | 112 | 912,4 | 957,4 | 3649,6 | 3829,6 |
| | | | | | 51 | 900,2 | 945,2 | 3600,8 | 3780,8 | 113 | 912,6 | 957,6 | 3650,4 | 3830,4 |
| | | | | | 52 | 900,4 | 945,4 | 3601,6 | 3781,6 | 114 | 912,8 | 957,8 | 3651,2 | 3831,2 |
| | | | | | 53 | 900,6 | 945,6 | 3602,4 | 3782,4 | 115 | 913,0 | 958,0 | 3652,0 | 3832,0 |
| | | | | | 54 | 900,8 | 945,8 | 3603,2 | 3783,2 | 116 | 913,2 | 958,2 | 3652,8 | 3832,8 |
| | | | | | 55 | 901,0 | 946,0 | 3604,0 | 3784,0 | 117 | 913,4 | 958,4 | 3653,6 | 3833,6 |
| | | | | | 56 | 901,2 | 946,2 | 3604,8 | 3784,8 | 118 | 913,6 | 958,6 | 3654,4 | 3834,4 |
| | | | | | 57 | 901,4 | 946,4 | 3605,6 | 3785,6 | 119 | 913,8 | 958,8 | 3655,2 | 3835,2 |
| | | | | | 58 | 901,6 | 946,6 | 3606,4 | 3786,4 | 120 | 914,0 | 959,0 | 3656,0 | 3836,0 |
| | | | | | 59 | 901,8 | 946,8 | 3607,2 | 3787,2 | 121 | 914,2 | 959,2 | 3656,8 | 3836,8 |
| | | | | | 60 | 902,0 | 947,0 | 3608,0 | 3788,0 | 122 | 914,4 | 959,4 | 3657,6 | 3837,6 |
| | | | | | 61 | 902,2 | 947,2 | 3608,8 | 3788,8 | 123 | 914,6 | 959,6 | 3658,4 | 3838,4 |
| | | | | | 62 | 902,4 | 947,4 | 3609,6 | 3789,6 | 124 | 914,8 | 959,8 | 3659,2 | 3839,2 |


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## GSM1800 frequencies

| Ch | Tx | Rx | VCO Tx | VCO Rx | Ch | Tx | Rx | VCO Tx | VCO Rx | Ch | Tx | Rx | VCO Tx | VCO Rx | Ch | Tx | Rx | VCO Tx | VCO Rx |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 512 | 1710.2 | 1805.2 | 3420.4 | 3610.4 | 606 | 1729.0 | 1824.0 | 3458.0 | 3648.0 | 700 | 1747.8 | 1842.8 | 3495.6 | 3685.6 | 793 | 1766.4 | 1861.4 | 3532.8 | 3722.8 |
| 513 | 1710.4 | 1805.4 | 3420.8 | 3610.8 | 607 | 1729.2 | 1824.2 | 3458.4 | 3648.4 | 701 | 1748.0 | 1843.0 | 3496.0 | 3686.0 | 794 | 1766.6 | 1861.6 | 3533.2 | 3723.2 |
| 514 | 1710.6 | 1805.6 | 3421.2 | 3611.2 | 608 | 1729.4 | 1824.4 | 3458.8 | 3648.8 | 702 | 1748.2 | 1843.2 | 3496.4 | 3686.4 | 795 | 1766.8 | 1861.8 | 3533.6 | 3723.6 |
| 515 | 1710.8 | 1805.8 | 3421.6 | 3611.6 | 609 | 1729.6 | 1824.6 | 3459.2 | 3649.2 | 703 | 1748.4 | 1843.4 | 3496.8 | 3686.8 | 796 | 1767.0 | 1862.0 | 3534.0 | 3724.0 |
| 516 | 1711.0 | 1806.0 | 3422.0 | 3612.0 | 610 | 1729.8 | 1824.8 | 3459.6 | 3649.6 | 704 | 1748.6 | 1843.6 | 3497.2 | 3687.2 | 797 | 1767.2 | 1862.2 | 3534.4 | 3724.4 |
| 517 | 1711.2 | 1806.2 | 3422.4 | 3612.4 | 611 | 1730.0 | 1825.0 | 3460.0 | 3650.0 | 705 | 1748.8 | 1843.8 | 3497.6 | 3687.6 | 798 | 1767.4 | 1862.4 | 3534.8 | 3724.8 |
| 518 | 1711.4 | 1806.4 | 3422.8 | 3612.8 | 612 | 1730.2 | 1825.2 | 3460.4 | 3650.4 | 706 | 1749.0 | 1844.0 | 3498.0 | 3688.0 | 799 | 1767.6 | 1862.6 | 3535.2 | 3725.2 |
| 519 | 1711.6 | 1806.6 | 3423.2 | 3613.2 | 613 | 1730.4 | 1825.4 | 3460.8 | 3650.8 | 707 | 1749.2 | 1844.2 | 3498.4 | 3688.4 | 800 | 1767.8 | 1862.8 | 3535.6 | 3725.6 |
| 520 | 1711.8 | 1806.8 | 3423.6 | 3613.6 | 614 | 1730.6 | 1825.6 | 3461.2 | 3651.2 | 708 | 1749.4 | 1844.4 | 3498.8 | 3688.8 | 801 | 1768.0 | 1863.0 | 3536.0 | 3726.0 |
| 521 | 1712.0 | 1807.0 | 3424.0 | 3614.0 | 615 | 1730.8 | 1825.8 | 3461.6 | 3651.6 | 709 | 1749.6 | 1844.6 | 3499.2 | 3689.2 | 802 | 1768.2 | 1863.2 | 3536.4 | 3726.4 |
| 522 | 1712.2 | 1807.2 | 3424.4 | 3614.4 | 616 | 1731.0 | 1826.0 | 3462.0 | 3652.0 | 710 | 1749.8 | 1844.8 | 3499.6 | 3689.6 | 803 | 1768.4 | 1863.4 | 3536.8 | 3726.8 |
| 523 | 1712.4 | 1807.4 | 3424.8 | 3614.8 | 617 | 1731.2 | 1826.2 | 3462.4 | 3652.4 | 711 | 1750.0 | 1845.0 | 3500.0 | 3690.0 | 804 | 1768.6 | 1863.6 | 3537.2 | 3727.2 |
| 524 | 1712.6 | 1807.6 | 3425.2 | 3615.2 | 618 | 1731.4 | 1826.4 | 3462.8 | 3652.8 | 712 | 1750.2 | 1845.2 | 3500.4 | 3690.4 | 805 | 1768.8 | 1863.8 | 3537.6 | 3727.6 |
| 525 | 1712.8 | 1807.8 | 3425.6 | 3615.6 | 619 | 1731.6 | 1826.6 | 3463.2 | 3653.2 | 713 | 1750.4 | 1845.4 | 3500.8 | 3690.8 | 806 | 1769.0 | 1864.0 | 3538.0 | 3728.0 |
| 526 | 1713.0 | 1808.0 | 3426.0 | 3616.0 | 620 | 1731.8 | 1826.8 | 3463.6 | 3653.6 | 714 | 1750.6 | 1845.6 | 3501.2 | 3691.2 | 807 | 1769.2 | 1864.2 | 3538.4 | 3728.4 |
| 527 | 1713.2 | 1808.2 | 3426.4 | 3616.4 | 621 | 1732.0 | 1827.0 | 3464.0 | 3654.0 | 715 | 1750.8 | 1845.8 | 3501.6 | 3691.6 | 808 | 1769.4 | 1864.4 | 3538.8 | 3728.8 |
| 528 | 1713.4 | 1808.4 | 3426.8 | 3616.8 | 622 | 1732.2 | 1827.2 | 3464.4 | 3654.4 | 716 | 1751.0 | 1846.0 | 3502.0 | 3692.0 | 809 | 1769.6 | 1864.6 | 3539.2 | 3729.2 |
| 529 | 1713.6 | 1808.6 | 3427.2 | 3617.2 | 623 | 1732.4 | 1827.4 | 3464.8 | 3654.8 | 717 | 1751.2 | 1846.2 | 3502.4 | 3692.4 | 810 | 1769.8 | 1864.8 | 3539.6 | 3729.6 |
| 530 | 1713.8 | 1808.8 | 3427.6 | 3617.6 | 624 | 1732.6 | 1827.6 | 3465.2 | 3655.2 | 718 | 1751.4 | 1846.4 | 3502.8 | 3692.8 | 811 | 1770.0 | 1865.0 | 3540.0 | 3730.0 |
| 531 | 1714.0 | 1809.0 | 3428.0 | 3618.0 | 625 | 1732.8 | 1827.8 | 3465.6 | 3655.6 | 719 | 1751.6 | 1846.6 | 3503.2 | 3693.2 | 812 | 1770.2 | 1865.2 | 3540.4 | 3730.4 |
| 532 | 1714.2 | 1809.2 | 3428.4 | 3618.4 | 626 | 1733.0 | 1828.0 | 3466.0 | 3656.0 | 720 | 1751.8 | 1846.8 | 3503.6 | 3693.6 | 813 | 1770.4 | 1865.4 | 3540.8 | 3730.8 |
| 533 | 1714.4 | 1809.4 | 3428.8 | 3618.8 | 627 | 1733.2 | 1828.2 | 3466.4 | 3656.4 | 721 | 1752.0 | 1847.0 | 3504.0 | 3694.0 | 814 | 1770.6 | 1865.6 | 3541.2 | 3731.2 |
| 534 | 1714.6 | 1809.6 | 3429.2 | 3619.2 | 628 | 1733.4 | 1828.4 | 3466.8 | 3656.8 | 722 | 1752.2 | 1847.2 | 3504.4 | 3694.4 | 815 | 1770.8 | 1865.8 | 3541.6 | 3731.6 |
| 535 | 1714.8 | 1809.8 | 3429.6 | 3619.6 | 629 | 1733.6 | 1828.6 | 3467.2 | 3657.2 | 723 | 1752.4 | 1847.4 | 3504.8 | 3694.8 | 816 | 1771.0 | 1866.0 | 3542.0 | 3732.0 |
| 536 | 1715.0 | 1810.0 | 3430.0 | 3620.0 | 630 | 1733.8 | 1828.8 | 3467.6 | 3657.6 | 724 | 1752.6 | 1847.6 | 3505.2 | 3695.2 | 817 | 1771.2 | 1866.2 | 3542.4 | 3732.4 |
| 537 | 1715.2 | 1810.2 | 3430.4 | 3620.4 | 631 | 1734.0 | 1829.0 | 3468.0 | 3658.0 | 725 | 1752.8 | 1847.8 | 3505.6 | 3695.6 | 818 | 1771.4 | 1866.4 | 3542.8 | 3732.8 |
| 538 | 1715.4 | 1810.4 | 3430.8 | 3620.8 | 632 | 1734.2 | 1829.2 | 3468.4 | 3658.4 | 726 | 1753.0 | 1848.0 | 3506.0 | 3696.0 | 819 | 1771.6 | 1866.6 | 3543.2 | 3733.2 |
| 539 | 1715.6 | 1810.6 | 3431.2 | 3621.2 | 633 | 1734.4 | 1829.4 | 3468.8 | 3658.8 | 727 | 1753.2 | 1848.2 | 3506.4 | 3696.4 | 820 | 1771.8 | 1866.8 | 3543.6 | 3733.6 |
| 540 | 1715.8 | 1810.8 | 3431.6 | 3621.6 | 634 | 1734.6 | 1829.6 | 3469.2 | 3659.2 | 728 | 1753.4 | 1848.4 | 3506.8 | 3696.8 | 821 | 1772.0 | 1867.0 | 3544.0 | 3734.0 |
| 541 | 1716.0 | 1811.0 | 3432.0 | 3622.0 | 635 | 1734.8 | 1829.8 | 3469.6 | 3659.6 | 729 | 1753.6 | 1848.6 | 3507.2 | 3697.2 | 822 | 1772.2 | 1867.2 | 3544.4 | 3734.4 |
| 542 | 1716.2 | 1811.2 | 3432.4 | 3622.4 | 636 | 1735.0 | 1830.0 | 3470.0 | 3660.0 | 730 | 1753.8 | 1848.8 | 3507.6 | 3697.6 | 823 | 1772.4 | 1867.4 | 3544.8 | 3734.8 |
| 543 | 1716.4 | 1811.4 | 3432.8 | 3622.8 | 637 | 1735.2 | 1830.2 | 3470.4 | 3660.4 | 731 | 1754.0 | 1849.0 | 3508.0 | 3698.0 | 824 | 1772.6 | 1867.6 | 3545.2 | 3735.2 |
| 544 | 1716.6 | 1811.6 | 3433.2 | 3623.2 | 638 | 1735.4 | 1830.4 | 3470.8 | 3660.8 | 732 | 1754.2 | 1849.2 | 3508.4 | 3698.4 | 825 | 1772.8 | 1867.8 | 3545.6 | 3735.6 |
| 545 | 1716.8 | 1811.8 | 3433.6 | 3623.6 | 639 | 1735.6 | 1830.6 | 3471.2 | 3661.2 | 733 | 1754.4 | 1849.4 | 3508.8 | 3698.8 | 826 | 1773.0 | 1868.0 | 3546.0 | 3736.0 |
| 546 | 1717.0 | 1812.0 | 3434.0 | 3624.0 | 640 | 1735.8 | 1830.8 | 3471.6 | 3661.6 | 734 | 1754.6 | 1849.6 | 3509.2 | 3699.2 | 827 | 1773.2 | 1868.2 | 3546.4 | 3736.4 |
| 547 | 1717.2 | 1812.2 | 3434.4 | 3624.4 | 641 | 1736.0 | 1831.0 | 3472.0 | 3662.0 | 735 | 1754.8 | 1849.8 | 3509.6 | 3699.6 | 828 | 1773.4 | 1868.4 | 3546.8 | 3736.8 |
| 548 | 1717.4 | 1812.4 | 3434.8 | 3624.8 | 642 | 1736.2 | 1831.2 | 3472.4 | 3662.4 | 736 | 1755.0 | 1850.0 | 3510.0 | 3700.0 | 829 | 1773.6 | 1868.6 | 3547.2 | 3737.2 |
| 549 | 1717.6 | 1812.6 | 3435.2 | 3625.2 | 643 | 1736.4 | 1831.4 | 3472.8 | 3662.8 | 737 | 1755.2 | 1850.2 | 3510.4 | 3700.4 | 830 | 1773.8 | 1868.8 | 3547.6 | 3737.6 |
| 550 | 1717.8 | 1812.8 | 3435.6 | 3625.6 | 644 | 1736.6 | 1831.6 | 3473.2 | 3663.2 | 738 | 1755.4 | 1850.4 | 3510.8 | 3700.8 | 831 | 1774.0 | 1869.0 | 3548.0 | 3738.0 |
| 551 | 1718.0 | 1813.0 | 3436.0 | 3626.0 | 645 | 1736.8 | 1831.8 | 3473.6 | 3663.6 | 739 | 1755.6 | 1850.6 | 3511.2 | 3701.2 | 832 | 1774.2 | 1869.2 | 3548.4 | 3738.4 |
| 552 | 1718.2 | 1813.2 | 3436.4 | 3626.4 | 646 | 1737.0 | 1832.0 | 3474.0 | 3664.0 | 740 | 1755.8 | 1850.8 | 3511.6 | 3701.6 | 833 | 1774.4 | 1869.4 | 3548.8 | 3738.8 |
| 553 | 1718.4 | 1813.4 | 3436.8 | 3626.8 | 647 | 1737.2 | 1832.2 | 3474.4 | 3664.4 | 741 | 1756.0 | 1851.0 | 3512.0 | 3702.0 | 834 | 1774.6 | 1869.6 | 3549.2 | 3739.2 |
| 554 | 1718.6 | 1813.6 | 3437.2 | 3627.2 | 648 | 1737.4 | 1832.4 | 3474.8 | 3664.8 | 742 | 1756.2 | 1851.2 | 3512.4 | 3702.4 | 835 | 1774.8 | 1869.8 | 3549.6 | 3739.6 |
| 555 | 1718.8 | 1813.8 | 3437.6 | 3627.6 | 649 | 1737.6 | 1832.6 | 3475.2 | 3665.2 | 743 | 1756.4 | 1851.4 | 3512.8 | 3702.8 | 836 | 1775.0 | 1870.0 | 3550.0 | 3740.0 |
| 556 | 1719.0 | 1814.0 | 3438.0 | 3628.0 | 650 | 1737.8 | 1832.8 | 3475.6 | 3665.6 | 744 | 1756.6 | 1851.6 | 3513.2 | 3703.2 | 837 | 1775.2 | 1870.2 | 3550.4 | 3740.4 |
| 557 | 1719.2 | 1814.2 | 3438.4 | 3628.4 | 651 | 1738.0 | 1833.0 | 3476.0 | 3666.0 | 745 | 1756.8 | 1851.8 | 3513.6 | 3703.6 | 838 | 1775.4 | 1870.4 | 3550.8 | 3740.8 |
| 558 | 1719.4 | 1814.4 | 3438.8 | 3628.8 | 652 | 1738.2 | 1833.2 | 3476.4 | 3666.4 | 746 | 1757.0 | 1852.0 | 3514.0 | 3704.0 | 839 | 1775.6 | 1870.6 | 3551.2 | 3741.2 |
| 559 | 1719.6 | 1814.6 | 3439.2 | 3629.2 | 653 | 1738.4 | 1833.4 | 3476.8 | 3666.8 | 747 | 1757.2 | 1852.2 | 3514.4 | 3704.4 | 840 | 1775.8 | 1870.8 | 3551.6 | 3741.6 |
| 560 | 1719.8 | 1814.8 | 3439.6 | 3629.6 | 654 | 1738.6 | 1833.6 | 3477.2 | 3667.2 | 748 | 1757.4 | 1852.4 | 3514.8 | 3704.8 | 841 | 1776.0 | 1871.0 | 3552.0 | 3742.0 |
| 561 | 1720.0 | 1815.0 | 3440.0 | 3630.0 | 655 | 1738.8 | 1833.8 | 3477.6 | 3667.6 | 749 | 1757.6 | 1852.6 | 3515.2 | 3705.2 | 842 | 1776.2 | 1871.2 | 3552.4 | 3742.4 |
| 562 | 1720.2 | 1815.2 | 3440.4 | 3630.4 | 656 | 1739.0 | 1834.0 | 3478.0 | 3668.0 | 750 | 1757.8 | 1852.8 | 3515.6 | 3705.6 | 843 | 1776.4 | 1871.4 | 3552.8 | 3742.8 |
| 563 | 1720.4 | 1815.4 | 3440.8 | 3630.8 | 657 | 1739.2 | 1834.2 | 3478.4 | 3668.4 | 751 | 1758.0 | 1853.0 | 3516.0 | 3706.0 | 844 | 1776.6 | 1871.6 | 3553.2 | 3743.2 |
| 564 | 1720.6 | 1815.6 | 3441.2 | 3631.2 | 658 | 1739.4 | 1834.4 | 3478.8 | 3668.8 | 752 | 1758.2 | 1853.2 | 3516.4 | 3706.4 | 845 | 1776.8 | 1871.8 | 3553.6 | 3743.6 |
| 565 | 1720.8 | 1815.8 | 3441.6 | 3631.6 | 659 | 1739.6 | 1834.6 | 3479.2 | 3669.2 | 753 | 1758.4 | 1853.4 | 3516.8 | 3706.8 | 846 | 1777.0 | 1872.0 | 3554.0 | 3744.0 |
| 566 | 1721.0 | 1816.0 | 3442.0 | 3632.0 | 660 | 1739.8 | 1834.8 | 3479.6 | 3669.6 | 754 | 1758.6 | 1853.6 | 3517.2 | 3707.2 | 847 | 1777.2 | 1872.2 | 3554.4 | 3744.4 |
| 567 | 1721.2 | 1816.2 | 3442.4 | 3632.4 | 661 | 1740.0 | 1835.0 | 3480.0 | 3670.0 | 755 | 1758.8 | 1853.8 | 3517.6 | 3707.6 | 848 | 1777.4 | 1872.4 | 3554.8 | 3744.8 |
| 568 | 1721.4 | 1816.4 | 3442.8 | 3632.8 | 662 | 1740.2 | 1835.2 | 3480.4 | 3670.4 | 756 | 1759.0 | 1854.0 | 3518.0 | 3708.0 | 849 | 1777.6 | 1872.6 | 3555.2 | 3745.2 |
| 569 | 1721.6 | 1816.6 | 3443.2 | 3633.2 | 663 | 1740.4 | 1835.4 | 3480.8 | 3670.8 | 757 | 1759.2 | 1854.2 | 3518.4 | 3708.4 | 850 | 1777.8 | 1872.8 | 3555.6 | 3745.6 |
| 570 | 1721.8 | 1816.8 | 3443.6 | 3633.6 | 664 | 1740.6 | 1835.6 | 3481.2 | 3671.2 | 758 | 1759.4 | 1854.4 | 3518.8 | 3708.8 | 851 | 1778.0 | 1873.0 | 3556.0 | 3746.0 |
| 571 | 1722.0 | 1817.0 | 3444.0 | 3634.0 | 665 | 1740.8 | 1835.8 | 3481.6 | 3671.6 | 759 | 1759.6 | 1854.6 | 3519.2 | 3709.2 | 852 | 1778.2 | 1873.2 | 3556.4 | 3746.4 |
| 572 | 1722.2 | 1817.2 | 3444.4 | 3634.4 | 666 | 1741.0 | 1836.0 | 3482.0 | 3672.0 | 760 | 1759.8 | 1854.8 | 3519.6 | 3709.6 | 853 | 1778.4 | 1873.4 | 3556.8 | 3746.8 |
| 573 | 1722.4 | 1817.4 | 3444.8 | 3634.8 | 667 | 1741.2 | 1836.2 | 3482.4 | 3672.4 | 761 | 1760.0 | 1855.0 | 3520.0 | 3710.0 | 854 | 1778.6 | 1873.6 | 3557.2 | 3747.2 |
| 574 | 1722.6 | 1817.6 | 3445.2 | 3635.2 | 668 | 1741.4 | 1836.4 | 3482.8 | 3672.8 | 762 | 1760.2 | 1855.2 | 3520.4 | 3710.4 | 855 | 1778.8 | 1873.8 | 3557.6 | 3747.6 |
| 575 | 1722.8 | 1817.8 | 3445.6 | 3635.6 | 669 | 1741.6 | 1836.6 | 3483.2 | 3673.2 | 763 | 1760.4 | 1855.4 | 3520.8 | 3710.8 | 856 | 1779.0 | 1874.0 | 3558.0 | 3748.0 |
| 576 | 1723.0 | 1818.0 | 3446.0 | 3636.0 | 670 | 1741.8 | 1836.8 | 3483.6 | 3673.6 | 764 | 1760.6 | 1855.6 | 3521.2 | 3711.2 | 857 | 1779.2 | 1874.2 | 3558.4 | 3748.4 |
| 577 | 1723.2 | 1818.2 | 3446.4 | 3636.4 | 671 | 1742.0 | 1837.0 | 3484.0 | 3674.0 | 765 | 1760.8 | 1855.8 | 3521.6 | 3711.6 | 858 | 1779.4 | 1874.4 | 3558.8 | 3748.8 |
| 578 | 1723.4 | 1818.4 | 3446.8 | 3636.8 | 672 | 1742.2 | 1837.2 | 3484.4 | 3674.4 | 766 | 1761.0 | 1856.0 | 3522.0 | 3712.0 | 859 | 1779.6 | 1874.6 | 3559.2 | 3749.2 |
| 579 | 1723.6 | 1818.6 | 3447.2 | 3637.2 | 673 | 1742.4 | 1837.4 | 3484.8 | 3674.8 | 767 | 1761.2 | 1856.2 | 3522.4 | 3712.4 | 860 | 1779.8 | 1874.8 | 3559.6 | 3749.6 |
| 580 | 1723.8 | 1818.8 | 3447.6 | 3637.6 | 674 | 1742.6 | 1837.6 | 3485.2 | 3675.2 | 768 | 1761.4 | 1856.4 | 3522.8 | 3712.8 | 861 | 1780.0 | 1875.0 | 3560.0 | 3750.0 |
| 581 | 1724.0 | 1819.0 | 3448.0 | 3638.0 | 675 | 1742.8 | 1837.8 | 3485.6 | 3675.6 | 769 | 1761.6 | 1856.6 | 3523.2 | 3713.2 | 862 | 1780.2 | 1875.2 | 3560.4 | 3750.4 |
| 582 | 1724.2 | 1819.2 | 3448.4 | 3638.4 | 676 | 1743.0 | 1838.0 | 3486.0 | 3676.0 | 770 | 1761.8 | 1856.8 | 3523.6 | 3713.6 | 863 | 1780.4 | 1875.4 | 3560.8 | 3750.8 |
| 583 | 1724.4 | 1819.4 | 3448.8 | 3638.8 | 677 | 1743.2 | 1838.2 | 3486.4 | 3676.4 | 771 | 1762.0 | 1857.0 | 3524.0 | 3714.0 | 864 | 1780.6 | 1875.6 | 3561.2 | 3751.2 |
| 584 | 1724.6 | 1819.6 | 3449.2 | 3639.2 | 678 | 1743.4 | 1838.4 | 3486.8 | 3676.8 | 772 | 1762.2 | 1857.2 | 3524.4 | 3714.4 | 865 | 1780.8 | 1875.8 | 3561.6 | 3751.6 |
| 585 | 1724.8 | 1819.8 | 3449.6 | 3639.6 | 679 | 1743.6 | 1838.6 | 3487.2 | 3677.2 | 773 | 1762.4 | 1857.4 | 3524.8 | 3714.8 | 866 | 1781.0 | 1876.0 | 3562.0 | 3752.0 |
| 586 | 1725.0 | 1820.0 | 3450.0 | 3640.0 | 680 | 1743.8 | 1838.8 | 3487.6 | 3677.6 | 774 | 1762.6 | 1857.6 | 3525.2 | 3715.2 | 867 | 1781.2 | 1876.2 | 3562.4 | 3752.4 |
| 587 | 1725.2 | 1820.2 | 3450.4 | 3640.4 | 681 | 1744.0 | 1839.0 | 3488.0 | 3678.0 | 775 | 1762.8 | 1857.8 | 3525.6 | 3715.6 | 868 | 1781.4 | 1876.4 | 3562.8 | 3752.8 |
| 588 | 1725.4 | 1820.4 | 3450.8 | 3640.8 | 682 | 1744.2 | 1839.2 | 3488.4 | 3678.4 | 776 | 1763.0 | 1858.0 | 3526.0 | 3716.0 | 869 | 1781.6 | 1876.6 | 3563.2 | 3753.2 |
| 589 | 1725.6 | 1820.6 | 3451.2 | 3641.2 | 683 | 1744.4 | 1839.4 | 3488.8 | 3678.8 | 777 | 1763.2 | 1858.2 | 3526.4 | 3716.4 | 870 | 1781.8 | 1876.8 | 3563.6 | 3753.6 |
| 590 | 1725.8 | 1820.8 | 3451.6 | 3641.6 | 684 | 1744.6 | 1839.6 | 3489.2 | 3679.2 | 778 | 1763.4 | 1858.4 | 3526.8 | 3716.8 | 871 | 1782.0 | 1877.0 | 3564.0 | 3754.0 |
| 591 | 1726.0 | 1821.0 | 3452.0 | 3642.0 | 685 | 1744.8 | 1839.8 | 3489.6 | 3679.6 | 779 | 1763.6 | 1858.6 | 3527.2 | 3717.2 | 872 | 1782.2 | 1877.2 | 3564.4 | 3754.4 |
| 592 | 1726.2 | 1821.2 | 3452.4 | 3642.4 | 686 | 1745.0 | 1840.0 | 3490.0 | 3680.0 | 780 | 1763.8 | 1858.8 | 3527.6 | 3717.6 | 873 | 1782.4 | 1877.4 | 3564.8 | 3754.8 |
| 593 | 1726.4 | 1821.4 | 3452.8 | 3642.8 | 687 | 1745.2 | 1840.2 | 3490.4 | 3680.4 | 781 | 1764.0 | 1859.0 | 3528.0 | 3718.0 | 874 | 1782.6 | 1877.6 | 3565.2 | 3755.2 |
| 594 | 1726.6 | 1821.6 | 3453.2 | 3643.2 | 688 | 1745.4 | 1840.4 | 3490.8 | 3680.8 | 782 | 1764.2 | 1859.2 | 3528.4 | 3718.4 | 875 | 1782.8 | 1877.8 | 3565.6 | 3755.6 |
| 595 | 1726.8 | 1821.8 | 3453.6 | 3643.6 | 689 | 1745.6 | 1840.6 | 3491.2 | 3681.2 | 783 | 1764.4 | 1859.4 | 3528.8 | 3718.8 | 876 | 1783.0 | 1878.0 | 3566.0 | 3756.0 |
| 596 | 1727.0 | 1822.0 | 3454.0 | 3644.0 | 690 | 1745.8 | 1840.8 | 3491.6 | 3681.6 | 784 | 1764.6 | 1859.6 | 3529.2 | 3719.2 | 877 | 1783.2 | 1878.2 | 3566.4 | 3756.4 |
| 597 | 1727.2 | 1822.2 | 3454.4 | 3644.4 | 691 | 1746.0 | 1841.0 | 3492.0 | 3682.0 | 785 | 1764.8 | 1859.8 | 3529.6 | 3719.6 | 878 | 1783.4 | 1878.4 | 3566.8 | 3756.8 |
| 598 | 1727.4 | 1822.4 | 3454.8 | 3644.8 | 692 | 1746.2 | 1841.2 | 3492.4 | 3682.4 | 786 | 1765.0 | 1860.0 | 3530.0 | 3720.0 | 879 | 1783.6 | 1878.6 | 3567.2 | 3757.2 |
| 599 | 1727.6 | 1822.6 | 3455.2 | 3645.2 | 693 | 1746.4 | 1841.4 | 3492.8 | 3682.8 | 787 | 1765.2 | 1860.2 | 3530.4 | 3720.4 | 880 | 1783.8 | 1878.8 | 3567.6 | 3757.6 |
| 600 | 1727.8 | 1822.8 | 3455.6 | 3645.6 | 694 | 1746.6 | 1841.6 | 3493.2 | 3683.2 | 788 | 1765.4 | 1860.4 | 3530.8 | 3720.8 | 881 | 1784.0 | 1879.0 | 3568.0 | 3758.0 |
| 601 | 1728.0 | 1823.0 | 3456.0 | 3646.0 | 695 | 1746.8 | 1841.8 | 3493.6 | 3683.6 | 789 | 1765.6 | 1860.6 | 3531.2 | 3721.2 | 882 | 1784.2 | 1879.2 | 3568.4 | 3758.4 |
| 602 | 1728.2 | 1823.2 | 3456.4 | 3646.4 | 696 | 1747.0 | 1842.0 | 3494.0 | 3684.0 | 790 | 1765.8 | 1860.8 | 3531.6 | 3721.6 | 883 | 1784.4 | 1879.4 | 3568.8 | 3758.8 |
| 603 | 1728.4 | 1823.4 | 3456.8 | 3646.8 | 697 | 1747.2 | 1842.2 | 3494.4 | 3684.4 | 791 | 1766.0 | 1861.0 | 3532.0 | 3722.0 | 884 | 1784.6 | 1879.6 | 3569.2 | 3759.2 |
| 604 | 1728.6 | 1823.6 | 3457.2 | 3647.2 | 698 | 1747.4 | 1842.4 | 3494.8 | 3684.8 | 792 | 1766.2 | 1861.2 | 3532.4 | 3722.4 | 885 | 1784.8 | 1879.8 | 3569.6 | 3759.6 |
| 605 | 1728.8 | 1823.8 | 3457.6 | 3647.6 | 699 | 1747.6 | 1842.6 | 3495.2 | 3685.2 | | | | | | | | | | |



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## GSM1900 frequencies

| CH | TX | RX | VCO TX | VCO RX | CH | TX | RX | VCO TX | VCO RX | CH | TX | RX | VCO TX | VCO RX | CH | TX | RX | VCO TX | VCO RX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 512 | 1850,2 | 1930,2 | 3700,4 | 3860,4 | 606 | 1869,0 | 1949,0 | 3738,0 | 3898,0 | 700 | 1887,8 | 1967,8 | 3775,6 | 3935,6 | 794 | 1906,6 | 1986,6 | 3813,2 | 3973,2 |
| 513 | 1850,4 | 1930,4 | 3700,8 | 3860,8 | 607 | 1869,2 | 1949,2 | 3738,4 | 3898,4 | 701 | 1888,0 | 1968,0 | 3776,0 | 3936,0 | 795 | 1906,8 | 1986,8 | 3813,6 | 3973,6 |
| 514 | 1850,6 | 1930,6 | 3701,2 | 3861,2 | 608 | 1869,4 | 1949,4 | 3738,8 | 3898,8 | 702 | 1888,2 | 1968,2 | 3776,4 | 3936,4 | 796 | 1907,0 | 1987,0 | 3814,0 | 3974,0 |
| 515 | 1850,8 | 1930,8 | 3701,6 | 3861,6 | 609 | 1869,6 | 1949,6 | 3739,2 | 3899,2 | 703 | 1888,4 | 1968,4 | 3776,8 | 3936,8 | 797 | 1907,2 | 1987,2 | 3814,4 | 3974,4 |
| 516 | 1851,0 | 1931,0 | 3702,0 | 3862,0 | 610 | 1869,8 | 1949,8 | 3739,6 | 3899,6 | 704 | 1888,6 | 1968,6 | 3777,2 | 3937,2 | 798 | 1907,4 | 1987,4 | 3814,8 | 3974,8 |
| 517 | 1851,2 | 1931,2 | 3702,4 | 3862,4 | 611 | 1870,0 | 1950,0 | 3740,0 | 3900,0 | 705 | 1888,8 | 1968,8 | 3777,6 | 3937,6 | 799 | 1907,6 | 1987,6 | 3815,2 | 3975,2 |
| 518 | 1851,4 | 1931,4 | 3702,8 | 3862,8 | 612 | 1870,2 | 1950,2 | 3740,4 | 3900,4 | 706 | 1889,0 | 1969,0 | 3778,0 | 3938,0 | 800 | 1907,8 | 1987,8 | 3815,6 | 3975,6 |
| 519 | 1851,6 | 1931,6 | 3703,2 | 3863,2 | 613 | 1870,4 | 1950,4 | 3740,8 | 3900,8 | 707 | 1889,2 | 1969,2 | 3778,4 | 3938,4 | 801 | 1908,0 | 1988,0 | 3816,0 | 3976,0 |
| 520 | 1851,8 | 1931,8 | 3703,6 | 3863,6 | 614 | 1870,6 | 1950,6 | 3741,2 | 3901,2 | 708 | 1889,4 | 1969,4 | 3778,8 | 3938,8 | 802 | 1908,2 | 1988,2 | 3816,4 | 3976,4 |
| 521 | 1852,0 | 1932,0 | 3704,0 | 3864,0 | 615 | 1870,8 | 1950,8 | 3741,6 | 3901,6 | 709 | 1889,6 | 1969,6 | 3779,2 | 3939,2 | 803 | 1908,4 | 1988,4 | 3816,8 | 3976,8 |
| 522 | 1852,2 | 1932,2 | 3704,4 | 3864,4 | 616 | 1871,0 | 1951,0 | 3742,0 | 3902,0 | 710 | 1889,8 | 1969,8 | 3779,6 | 3939,6 | 804 | 1908,6 | 1988,6 | 3817,2 | 3977,2 |
| 523 | 1852,4 | 1932,4 | 3704,8 | 3864,8 | 617 | 1871,2 | 1951,2 | 3742,4 | 3902,4 | 711 | 1890,0 | 1970,0 | 3780,0 | 3940,0 | 805 | 1908,8 | 1988,8 | 3817,6 | 3977,6 |
| 524 | 1852,6 | 1932,6 | 3705,2 | 3865,2 | 618 | 1871,4 | 1951,4 | 3742,8 | 3902,8 | 712 | 1890,2 | 1970,2 | 3780,4 | 3940,4 | 806 | 1909,0 | 1989,0 | 3818,0 | 3978,0 |
| 525 | 1852,8 | 1932,8 | 3705,6 | 3865,6 | 619 | 1871,6 | 1951,6 | 3743,2 | 3903,2 | 713 | 1890,4 | 1970,4 | 3780,8 | 3940,8 | 807 | 1909,2 | 1989,2 | 3818,4 | 3978,4 |
| 526 | 1853,0 | 1933,0 | 3706,0 | 3866,0 | 620 | 1871,8 | 1951,8 | 3743,6 | 3903,6 | 714 | 1890,6 | 1970,6 | 3781,2 | 3941,2 | 808 | 1909,4 | 1989,4 | 3818,8 | 3978,8 |
| 527 | 1853,2 | 1933,2 | 3706,4 | 3866,4 | 621 | 1872,0 | 1952,0 | 3744,0 | 3904,0 | 715 | 1890,8 | 1970,8 | 3781,6 | 3941,6 | 809 | 1909,6 | 1989,6 | 3819,2 | 3979,2 |
| 528 | 1853,4 | 1933,4 | 3706,8 | 3866,8 | 622 | 1872,2 | 1952,2 | 3744,4 | 3904,4 | 716 | 1891,0 | 1971,0 | 3782,0 | 3942,0 | 810 | 1909,8 | 1989,8 | 3819,6 | 3979,6 |
| 529 | 1853,6 | 1933,6 | 3707,2 | 3867,2 | 623 | 1872,4 | 1952,4 | 3744,8 | 3904,8 | 717 | 1891,2 | 1971,2 | 3782,4 | 3942,4 | | | | | |
| 530 | 1853,8 | 1933,8 | 3707,6 | 3867,6 | 624 | 1872,6 | 1952,6 | 3745,2 | 3905,2 | 718 | 1891,4 | 1971,4 | 3782,8 | 3942,8 | | | | | |
| 531 | 1854,0 | 1934,0 | 3708,0 | 3868,0 | 625 | 1872,8 | 1952,8 | 3745,6 | 3905,6 | 719 | 1891,6 | 1971,6 | 3783,2 | 3943,2 | | | | | |
| 532 | 1854,2 | 1934,2 | 3708,4 | 3868,4 | 626 | 1873,0 | 1953,0 | 3746,0 | 3906,0 | 720 | 1891,8 | 1971,8 | 3783,6 | 3943,6 | | | | | |
| 533 | 1854,4 | 1934,4 | 3708,8 | 3868,8 | 627 | 1873,2 | 1953,2 | 3746,4 | 3906,4 | 721 | 1892,0 | 1972,0 | 3784,0 | 3944,0 | | | | | |
| 534 | 1854,6 | 1934,6 | 3709,2 | 3869,2 | 628 | 1873,4 | 1953,4 | 3746,8 | 3906,8 | 722 | 1892,2 | 1972,2 | 3784,4 | 3944,4 | | | | | |
| 535 | 1854,8 | 1934,8 | 3709,6 | 3869,6 | 629 | 1873,6 | 1953,6 | 3747,2 | 3907,2 | 723 | 1892,4 | 1972,4 | 3784,8 | 3944,8 | | | | | |
| 536 | 1855,0 | 1935,0 | 3710,0 | 3870,0 | 630 | 1873,8 | 1953,8 | 3747,6 | 3907,6 | 724 | 1892,6 | 1972,6 | 3785,2 | 3945,2 | | | | | |
| 537 | 1855,2 | 1935,2 | 3710,4 | 3870,4 | 631 | 1874,0 | 1954,0 | 3748,0 | 3908,0 | 725 | 1892,8 | 1972,8 | 3785,6 | 3945,6 | | | | | |
| 538 | 1855,4 | 1935,4 | 3710,8 | 3870,8 | 632 | 1874,2 | 1954,2 | 3748,4 | 3908,4 | 726 | 1893,0 | 1973,0 | 3786,0 | 3946,0 | | | | | |
| 539 | 1855,6 | 1935,6 | 3711,2 | 3871,2 | 633 | 1874,4 | 1954,4 | 3748,8 | 3908,8 | 727 | 1893,2 | 1973,2 | 3786,4 | 3946,4 | | | | | |
| 540 | 1855,8 | 1935,8 | 3711,6 | 3871,6 | 634 | 1874,6 | 1954,6 | 3749,2 | 3909,2 | 728 | 1893,4 | 1973,4 | 3786,8 | 3946,8 | | | | | |
| 541 | 1856,0 | 1936,0 | 3712,0 | 3872,0 | 635 | 1874,8 | 1954,8 | 3749,6 | 3909,6 | 729 | 1893,6 | 1973,6 | 3787,2 | 3947,2 | | | | | |
| 542 | 1856,2 | 1936,2 | 3712,4 | 3872,4 | 636 | 1875,0 | 1955,0 | 3750,0 | 3910,0 | 730 | 1893,8 | 1973,8 | 3787,6 | 3947,6 | | | | | |
| 543 | 1856,4 | 1936,4 | 3712,8 | 3872,8 | 637 | 1875,2 | 1955,2 | 3750,4 | 3910,4 | 731 | 1894,0 | 1974,0 | 3788,0 | 3948,0 | | | | | |
| 544 | 1856,6 | 1936,6 | 3713,2 | 3873,2 | 638 | 1875,4 | 1955,4 | 3750,8 | 3910,8 | 732 | 1894,2 | 1974,2 | 3788,4 | 3948,4 | | | | | |
| 545 | 1856,8 | 1936,8 | 3713,6 | 3873,6 | 639 | 1875,6 | 1955,6 | 3751,2 | 3911,2 | 733 | 1894,4 | 1974,4 | 3788,8 | 3948,8 | | | | | |
| 546 | 1857,0 | 1937,0 | 3714,0 | 3874,0 | 640 | 1875,8 | 1955,8 | 3751,6 | 3911,6 | 734 | 1894,6 | 1974,6 | 3789,2 | 3949,2 | | | | | |
| 547 | 1857,2 | 1937,2 | 3714,4 | 3874,4 | 641 | 1876,0 | 1956,0 | 3752,0 | 3912,0 | 735 | 1894,8 | 1974,8 | 3789,6 | 3949,6 | | | | | |
| 548 | 1857,4 | 1937,4 | 3714,8 | 3874,8 | 642 | 1876,2 | 1956,2 | 3752,4 | 3912,4 | 736 | 1895,0 | 1975,0 | 3790,0 | 3950,0 | | | | | |
| 549 | 1857,6 | 1937,6 | 3715,2 | 3875,2 | 643 | 1876,4 | 1956,4 | 3752,8 | 3912,8 | 737 | 1895,2 | 1975,2 | 3790,4 | 3950,4 | | | | | |
| 550 | 1857,8 | 1937,8 | 3715,6 | 3875,6 | 644 | 1876,6 | 1956,6 | 3753,2 | 3913,2 | 738 | 1895,4 | 1975,4 | 3790,8 | 3950,8 | | | | | |
| 551 | 1858,0 | 1938,0 | 3716,0 | 3876,0 | 645 | 1876,8 | 1956,8 | 3753,6 | 3913,6 | 739 | 1895,6 | 1975,6 | 3791,2 | 3951,2 | | | | | |
| 552 | 1858,2 | 1938,2 | 3716,4 | 3876,4 | 646 | 1877,0 | 1957,0 | 3754,0 | 3914,0 | 740 | 1895,8 | 1975,8 | 3791,6 | 3951,6 | | | | | |
| 553 | 1858,4 | 1938,4 | 3716,8 | 3876,8 | 647 | 1877,2 | 1957,2 | 3754,4 | 3914,4 | 741 | 1896,0 | 1976,0 | 3792,0 | 3952,0 | | | | | |
| 554 | 1858,6 | 1938,6 | 3717,2 | 3877,2 | 648 | 1877,4 | 1957,4 | 3754,8 | 3914,8 | 742 | 1896,2 | 1976,2 | 3792,4 | 3952,4 | | | | | |
| 555 | 1858,8 | 1938,8 | 3717,6 | 3877,6 | 649 | 1877,6 | 1957,6 | 3755,2 | 3915,2 | 743 | 1896,4 | 1976,4 | 3792,8 | 3952,8 | | | | | |
| 556 | 1859,0 | 1939,0 | 3718,0 | 3878,0 | 650 | 1877,8 | 1957,8 | 3755,6 | 3915,6 | 744 | 1896,6 | 1976,6 | 3793,2 | 3953,2 | | | | | |
| 557 | 1859,2 | 1939,2 | 3718,4 | 3878,4 | 651 | 1878,0 | 1958,0 | 3756,0 | 3916,0 | 745 | 1896,8 | 1976,8 | 3793,6 | 3953,6 | | | | | |
| 558 | 1859,4 | 1939,4 | 3718,8 | 3878,8 | 652 | 1878,2 | 1958,2 | 3756,4 | 3916,4 | 746 | 1897,0 | 1977,0 | 3794,0 | 3954,0 | | | | | |
| 559 | 1859,6 | 1939,6 | 3719,2 | 3879,2 | 653 | 1878,4 | 1958,4 | 3756,8 | 3916,8 | 747 | 1897,2 | 1977,2 | 3794,4 | 3954,4 | | | | | |
| 560 | 1859,8 | 1939,8 | 3719,6 | 3879,6 | 654 | 1878,6 | 1958,6 | 3757,2 | 3917,2 | 748 | 1897,4 | 1977,4 | 3794,8 | 3954,8 | | | | | |
| 561 | 1860,0 | 1940,0 | 3720,0 | 3880,0 | 655 | 1878,8 | 1958,8 | 3757,6 | 3917,6 | 749 | 1897,6 | 1977,6 | 3795,2 | 3955,2 | | | | | |
| 562 | 1860,2 | 1940,2 | 3720,4 | 3880,4 | 656 | 1879,0 | 1959,0 | 3758,0 | 3918,0 | 750 | 1897,8 | 1977,8 | 3795,6 | 3955,6 | | | | | |
| 563 | 1860,4 | 1940,4 | 3720,8 | 3880,8 | 657 | 1879,2 | 1959,2 | 3758,4 | 3918,4 | 751 | 1898,0 | 1978,0 | 3796,0 | 3956,0 | | | | | |
| 564 | 1860,6 | 1940,6 | 3721,2 | 3881,2 | 658 | 1879,4 | 1959,4 | 3758,8 | 3918,8 | 752 | 1898,2 | 1978,2 | 3796,4 | 3956,4 | | | | | |
| 565 | 1860,8 | 1940,8 | 3721,6 | 3881,6 | 659 | 1879,6 | 1959,6 | 3759,2 | 3919,2 | 753 | 1898,4 | 1978,4 | 3796,8 | 3956,8 | | | | | |
| 566 | 1861,0 | 1941,0 | 3722,0 | 3882,0 | 660 | 1879,8 | 1959,8 | 3759,6 | 3919,6 | 754 | 1898,6 | 1978,6 | 3797,2 | 3957,2 | | | | | |
| 567 | 1861,2 | 1941,2 | 3722,4 | 3882,4 | 661 | 1880,0 | 1960,0 | 3760,0 | 3920,0 | 755 | 1898,8 | 1978,8 | 3797,6 | 3957,6 | | | | | |
| 568 | 1861,4 | 1941,4 | 3722,8 | 3882,8 | 662 | 1880,2 | 1960,2 | 3760,4 | 3920,4 | 756 | 1899,0 | 1979,0 | 3798,0 | 3958,0 | | | | | |
| 569 | 1861,6 | 1941,6 | 3723,2 | 3883,2 | 663 | 1880,4 | 1960,4 | 3760,8 | 3920,8 | 757 | 1899,2 | 1979,2 | 3798,4 | 3958,4 | | | | | |
| 570 | 1861,8 | 1941,8 | 3723,6 | 3883,6 | 664 | 1880,6 | 1960,6 | 3761,2 | 3921,2 | 758 | 1899,4 | 1979,4 | 3798,8 | 3958,8 | | | | | |
| 571 | 1862,0 | 1942,0 | 3724,0 | 3884,0 | 665 | 1880,8 | 1960,8 | 3761,6 | 3921,6 | 759 | 1899,6 | 1979,6 | 3799,2 | 3959,2 | | | | | |
| 572 | 1862,2 | 1942,2 | 3724,4 | 3884,4 | 666 | 1881,0 | 1961,0 | 3762,0 | 3922,0 | 760 | 1899,8 | 1979,8 | 3799,6 | 3959,6 | | | | | |
| 573 | 1862,4 | 1942,4 | 3724,8 | 3884,8 | 667 | 1881,2 | 1961,2 | 3762,4 | 3922,4 | 761 | 1900,0 | 1980,0 | 3800,0 | 3960,0 | | | | | |
| 574 | 1862,6 | 1942,6 | 3725,2 | 3885,2 | 668 | 1881,4 | 1961,4 | 3762,8 | 3922,8 | 762 | 1900,2 | 1980,2 | 3800,4 | 3960,4 | | | | | |
| 575 | 1862,8 | 1942,8 | 3725,6 | 3885,6 | 669 | 1881,6 | 1961,6 | 3763,2 | 3923,2 | 763 | 1900,4 | 1980,4 | 3800,8 | 3960,8 | | | | | |
| 576 | 1863,0 | 1943,0 | 3726,0 | 3886,0 | 670 | 1881,8 | 1961,8 | 3763,6 | 3923,6 | 764 | 1900,6 | 1980,6 | 3801,2 | 3961,2 | | | | | |
| 577 | 1863,2 | 1943,2 | 3726,4 | 3886,4 | 671 | 1882,0 | 1962,0 | 3764,0 | 3924,0 | 765 | 1900,8 | 1980,8 | 3801,6 | 3961,6 | | | | | |
| 578 | 1863,4 | 1943,4 | 3726,8 | 3886,8 | 672 | 1882,2 | 1962,2 | 3764,4 | 3924,4 | 766 | 1901,0 | 1981,0 | 3802,0 | 3962,0 | | | | | |
| 579 | 1863,6 | 1943,6 | 3727,2 | 3887,2 | 673 | 1882,4 | 1962,4 | 3764,8 | 3924,8 | 767 | 1901,2 | 1981,2 | 3802,4 | 3962,4 | | | | | |
| 580 | 1863,8 | 1943,8 | 3727,6 | 3887,6 | 674 | 1882,6 | 1962,6 | 3765,2 | 3925,2 | 768 | 1901,4 | 1981,4 | 3802,8 | 3962,8 | | | | | |
| 581 | 1864,0 | 1944,0 | 3728,0 | 3888,0 | 675 | 1882,8 | 1962,8 | 3765,6 | 3925,6 | 769 | 1901,6 | 1981,6 | 3803,2 | 3963,2 | | | | | |
| 582 | 1864,2 | 1944,2 | 3728,4 | 3888,4 | 676 | 1883,0 | 1963,0 | 3766,0 | 3926,0 | 770 | 1901,8 | 1981,8 | 3803,6 | 3963,6 | | | | | |
| 583 | 1864,4 | 1944,4 | 3728,8 | 3888,8 | 677 | 1883,2 | 1963,2 | 3766,4 | 3926,4 | 771 | 1902,0 | 1982,0 | 3804,0 | 3964,0 | | | | | |
| 584 | 1864,6 | 1944,6 | 3729,2 | 3889,2 | 678 | 1883,4 | 1963,4 | 3766,8 | 3926,8 | 772 | 1902,2 | 1982,2 | 3804,4 | 3964,4 | | | | | |
| 585 | 1864,8 | 1944,8 | 3729,6 | 3889,6 | 679 | 1883,6 | 1963,6 | 3767,2 | 3927,2 | 773 | 1902,4 | 1982,4 | 3804,8 | 3964,8 | | | | | |
| 586 | 1865,0 | 1945,0 | 3730,0 | 3890,0 | 680 | 1883,8 | 1963,8 | 3767,6 | 3927,6 | 774 | 1902,6 | 1982,6 | 3805,2 | 3965,2 | | | | | |
| 587 | 1865,2 | 1945,2 | 3730,4 | 3890,4 | 681 | 1884,0 | 1964,0 | 3768,0 | 3928,0 | 775 | 1902,8 | 1982,8 | 3805,6 | 3965,6 | | | | | |
| 588 | 1865,4 | 1945,4 | 3730,8 | 3890,8 | 682 | 1884,2 | 1964,2 | 3768,4 | 3928,4 | 776 | 1903,0 | 1983,0 | 3806,0 | 3966,0 | | | | | |
| 589 | 1865,6 | 1945,6 | 3731,2 | 3891,2 | 683 | 1884,4 | 1964,4 | 3768,8 | 3928,8 | 777 | 1903,2 | 1983,2 | 3806,4 | 3966,4 | | | | | |
| 590 | 1865,8 | 1945,8 | 3731,6 | 3891,6 | 684 | 1884,6 | 1964,6 | 3769,2 | 3929,2 | 778 | 1903,4 | 1983,4 | 3806,8 | 3966,8 | | | | | |
| 591 | 1866,0 | 1946,0 | 3732,0 | 3892,0 | 685 | 1884,8 | 1964,8 | 3769,6 | 3929,6 | 779 | 1903,6 | 1983,6 | 3807,2 | 3967,2 | | | | | |
| 592 | 1866,2 | 1946,2 | 3732,4 | 3892,4 | 686 | 1885,0 | 1965,0 | 3770,0 | 3930,0 | 780 | 1903,8 | 1983,8 | 3807,6 | 3967,6 | | | | | |
| 593 | 1866,4 | 1946,4 | 3732,8 | 3892,8 | 687 | 1885,2 | 1965,2 | 3770,4 | 3930,4 | 781 | 1904,0 | 1984,0 | 3808,0 | 3968,0 | | | | | |
| 594 | 1866,6 | 1946,6 | 3733,2 | 3893,2 | 688 | 1885,4 | 1965,4 | 3770,8 | 3930,8 | 782 | 1904,2 | 1984,2 | 3808,4 | 3968,4 | | | | | |
| 595 | 1866,8 | 1946,8 | 3733,6 | 3893,6 | 689 | 1885,6 | 1965,6 | 3771,2 | 3931,2 | 783 | 1904,4 | 1984,4 | 3808,8 | 3968,8 | | | | | |
| 596 | 1867,0 | 1947,0 | 3734,0 | 3894,0 | 690 | 1885,8 | 1965,8 | 3771,6 | 3931,6 | 784 | 1904,6 | 1984,6 | 3809,2 | 3969,2 | | | | | |
| 597 | 1867,2 | 1947,2 | 3734,4 | 3894,4 | 691 | 1886,0 | 1966,0 | 3772,0 | 3932,0 | 785 | 1904,8 | 1984,8 | 3809,6 | 3969,6 | | | | | |
| 598 | 1867,4 | 1947,4 | 3734,8 | 3894,8 | 692 | 1886,2 | 1966,2 | 3772,4 | 3932,4 | 786 | 1905,0 | 1985,0 | 3810,0 | 3970,0 | | | | | |
| 599 | 1867,6 | 1947,6 | 3735,2 | 3895,2 | 693 | 1886,4 | 1966,4 | 3772,8 | 3932,8 | 787 | 1905,2 | 1985,2 | 3810,4 | 3970,4 | | | | | |
| 600 | 1867,8 | 1947,8 | 3735,6 | 3895,6 | 694 | 1886,6 | 1966,6 | 3773,2 | 3933,2 | 788 | 1905,4 | 1985,4 | 3810,8 | 3970,8 | | | | | |
| 601 | 1868,0 | 1948,0 | 3736,0 | 3896,0 | 695 | 1886,8 | 1966,8 | 3773,6 | 3933,6 | 789 | 1905,6 | 1985,6 | 3811,2 | 3971,2 | | | | | |
| 602 | 1868,2 | 1948,2 | 3736,4 | 3896,4 | 696 | 1887,0 | 1967,0 | 3774,0 | 3934,0 | 790 | 1905,8 | 1985,8 | 3811,6 | 3971,6 | | | | | |
| 603 | 1868,4 | 1948,4 | 3736,8 | 3896,8 | 697 | 1887,2 | 1967,2 | 3774,4 | 3934,4 | 791 | 1906,0 | 1986,0 | 3812,0 | 3972,0 | | | | | |
| 604 | 1868,6 | 1948,6 | 3737,2 | 3897,2 | 698 | 1887,4 | 1967,4 | 3774,8 | 3934,8 | 792 | 1906,2 | 1986,2 | 3812,4 | 3972,4 | | | | | |
| 605 | 1868,8 | 1948,8 | 3737,6 | 3897,6 | 699 | 1887,6 | 1967,6 | 3775,2 | 3935,2 | 793 | 1906,4 | 1986,4 | 3812,8 | 3972,8 | | | | | |


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## WCDMA 2100 Rx frequencies

| Ch | RX | VCO RX | Ch | RX | VCO RX | Ch | RX | VCO RX | Ch | RX | VCO RX | Ch | RX | VCO RX |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10562 | 2112.4 | 4224.8 | 10625 | 2125 | 4250 | 10688 | 2137.6 | 4275.2 | 10751 | 2150.2 | 4300.4 | 10814 | 2162.8 | 4325.6 |
| 10563 | 2112.6 | 4225.2 | 10626 | 2125.2 | 4250.4 | 10689 | 2137.8 | 4275.6 | 10752 | 2150.4 | 4300.8 | 10815 | 2163 | 4326 |
| 10564 | 2112.8 | 4225.6 | 10627 | 2125.4 | 4250.8 | 10690 | 2138 | 4276 | 10753 | 2150.6 | 4301.2 | 10816 | 2163.2 | 4326.4 |
| 10565 | 2113 | 4226 | 10628 | 2125.6 | 4251.2 | 10691 | 2138.2 | 4276.4 | 10754 | 2150.8 | 4301.6 | 10817 | 2163.4 | 4326.8 |
| 10566 | 2113.2 | 4226.4 | 10629 | 2125.8 | 4251.6 | 10692 | 2138.4 | 4276.8 | 10755 | 2151 | 4302 | 10818 | 2163.6 | 4327.2 |
| 10567 | 2113.4 | 4226.8 | 10630 | 2126 | 4252 | 10693 | 2138.6 | 4277.2 | 10756 | 2151.2 | 4302.4 | 10819 | 2163.8 | 4327.6 |
| 10568 | 2113.6 | 4227.2 | 10631 | 2126.2 | 4252.4 | 10694 | 2138.8 | 4277.6 | 10757 | 2151.4 | 4302.8 | 10820 | 2164 | 4328 |
| 10569 | 2113.8 | 4227.6 | 10632 | 2126.4 | 4252.8 | 10695 | 2139 | 4278 | 10758 | 2151.6 | 4303.2 | 10821 | 2164.2 | 4328.4 |
| 10570 | 2114 | 4228 | 10633 | 2126.6 | 4253.2 | 10696 | 2139.2 | 4278.4 | 10759 | 2151.8 | 4303.6 | 10822 | 2164.4 | 4328.8 |
| 10571 | 2114.2 | 4228.4 | 10634 | 2126.8 | 4253.6 | 10697 | 2139.4 | 4278.8 | 10760 | 2152 | 4304 | 10823 | 2164.6 | 4329.2 |
| 10572 | 2114.4 | 4228.8 | 10635 | 2127 | 4254 | 10698 | 2139.6 | 4279.2 | 10761 | 2152.2 | 4304.4 | 10824 | 2164.8 | 4329.6 |
| 10573 | 2114.6 | 4229.2 | 10636 | 2127.2 | 4254.4 | 10699 | 2139.8 | 4279.6 | 10762 | 2152.4 | 4304.8 | 10825 | 2165 | 4330 |
| 10574 | 2114.8 | 4229.6 | 10637 | 2127.4 | 4254.8 | 10700 | 2140 | 4280 | 10763 | 2152.6 | 4305.2 | 10826 | 2165.2 | 4330.4 |
| 10575 | 2115 | 4230 | 10638 | 2127.6 | 4255.2 | 10701 | 2140.2 | 4280.4 | 10764 | 2152.8 | 4305.6 | 10827 | 2165.4 | 4330.8 |
| 10576 | 2115.2 | 4230.4 | 10639 | 2127.8 | 4255.6 | 10702 | 2140.4 | 4280.8 | 10765 | 2153 | 4306 | 10828 | 2165.6 | 4331.2 |
| 10577 | 2115.4 | 4230.8 | 10640 | 2128 | 4256 | 10703 | 2140.6 | 4281.2 | 10766 | 2153.2 | 4306.4 | 10829 | 2165.8 | 4331.6 |
| 10578 | 2115.6 | 4231.2 | 10641 | 2128.2 | 4256.4 | 10704 | 2140.8 | 4281.6 | 10767 | 2153.4 | 4306.8 | 10830 | 2166 | 4332 |
| 10579 | 2115.8 | 4231.6 | 10642 | 2128.4 | 4256.8 | 10705 | 2141 | 4282 | 10768 | 2153.6 | 4307.2 | 10831 | 2166.2 | 4332.4 |
| 10580 | 2116 | 4232 | 10643 | 2128.6 | 4257.2 | 10706 | 2141.2 | 4282.4 | 10769 | 2153.8 | 4307.6 | 10832 | 2166.4 | 4332.8 |
| 10581 | 2116.2 | 4232.4 | 10644 | 2128.8 | 4257.6 | 10707 | 2141.4 | 4282.8 | 10770 | 2154 | 4308 | 10833 | 2166.6 | 4333.2 |
| 10582 | 2116.4 | 4232.8 | 10645 | 2129 | 4258 | 10708 | 2141.6 | 4283.2 | 10771 | 2154.2 | 4308.4 | 10834 | 2166.8 | 4333.6 |
| 10583 | 2116.6 | 4233.2 | 10646 | 2129.2 | 4258.4 | 10709 | 2141.8 | 4283.6 | 10772 | 2154.4 | 4308.8 | 10835 | 2167 | 4334 |
| 10584 | 2116.8 | 4233.6 | 10647 | 2129.4 | 4258.8 | 10710 | 2142 | 4284 | 10773 | 2154.6 | 4309.2 | 10836 | 2167.2 | 4334.4 |
| 10585 | 2117 | 4234 | 10648 | 2129.6 | 4259.2 | 10711 | 2142.2 | 4284.4 | 10774 | 2154.8 | 4309.6 | 10837 | 2167.4 | 4334.8 |
| 10586 | 2117.2 | 4234.4 | 10649 | 2129.8 | 4259.6 | 10712 | 2142.4 | 4284.8 | 10775 | 2155 | 4310 | 10838 | 2167.6 | 4335.2 |
| 10587 | 2117.4 | 4234.8 | 10650 | 2130 | 4260 | 10713 | 2142.6 | 4285.2 | 10776 | 2155.2 | 4310.4 | | | |
| 10588 | 2117.6 | 4235.2 | 10651 | 2130.2 | 4260.4 | 10714 | 2142.8 | 4285.6 | 10777 | 2155.4 | 4310.8 | | | |
| 10589 | 2117.8 | 4235.6 | 10652 | 2130.4 | 4260.8 | 10715 | 2143 | 4286 | 10778 | 2155.6 | 4311.2 | | | |
| 10590 | 2118 | 4236 | 10653 | 2130.6 | 4261.2 | 10716 | 2143.2 | 4286.4 | 10779 | 2155.8 | 4311.6 | | | |
| 10591 | 2118.2 | 4236.4 | 10654 | 2130.8 | 4261.6 | 10717 | 2143.4 | 4286.8 | 10780 | 2156 | 4312 | | | |
| 10592 | 2118.4 | 4236.8 | 10655 | 2131 | 4262 | 10718 | 2143.6 | 4287.2 | 10781 | 2156.2 | 4312.4 | | | |
| 10593 | 2118.6 | 4237.2 | 10656 | 2131.2 | 4262.4 | 10719 | 2143.8 | 4287.6 | 10782 | 2156.4 | 4312.8 | | | |
| 10594 | 2118.8 | 4237.6 | 10657 | 2131.4 | 4262.8 | 10720 | 2144 | 4288 | 10783 | 2156.6 | 4313.2 | | | |
| 10595 | 2119 | 4238 | 10658 | 2131.6 | 4263.2 | 10721 | 2144.2 | 4288.4 | 10784 | 2156.8 | 4313.6 | | | |
| 10596 | 2119.2 | 4238.4 | 10659 | 2131.8 | 4263.6 | 10722 | 2144.4 | 4288.8 | 10785 | 2157 | 4314 | | | |
| 10597 | 2119.4 | 4238.8 | 10660 | 2132 | 4264 | 10723 | 2144.6 | 4289.2 | 10786 | 2157.2 | 4314.4 | | | |
| 10598 | 2119.6 | 4239.2 | 10661 | 2132.2 | 4264.4 | 10724 | 2144.8 | 4289.6 | 10787 | 2157.4 | 4314.8 | | | |
| 10599 | 2119.8 | 4239.6 | 10662 | 2132.4 | 4264.8 | 10725 | 2145 | 4290 | 10788 | 2157.6 | 4315.2 | | | |
| 10600 | 2120 | 4240 | 10663 | 2132.6 | 4265.2 | 10726 | 2145.2 | 4290.4 | 10789 | 2157.8 | 4315.6 | | | |
| 10601 | 2120.2 | 4240.4 | 10664 | 2132.8 | 4265.6 | 10727 | 2145.4 | 4290.8 | 10790 | 2158 | 4316 | | | |
| 10602 | 2120.4 | 4240.8 | 10665 | 2133 | 4266 | 10728 | 2145.6 | 4291.2 | 10791 | 2158.2 | 4316.4 | | | |
| 10603 | 2120.6 | 4241.2 | 10666 | 2133.2 | 4266.4 | 10729 | 2145.8 | 4291.6 | 10792 | 2158.4 | 4316.8 | | | |
| 10604 | 2120.8 | 4241.6 | 10667 | 2133.4 | 4266.8 | 10730 | 2146 | 4292 | 10793 | 2158.6 | 4317.2 | | | |
| 10605 | 2121 | 4242 | 10668 | 2133.6 | 4267.2 | 10731 | 2146.2 | 4292.4 | 10794 | 2158.8 | 4317.6 | | | |
| 10606 | 2121.2 | 4242.4 | 10669 | 2133.8 | 4267.6 | 10732 | 2146.4 | 4292.8 | 10795 | 2159 | 4318 | | | |
| 10607 | 2121.4 | 4242.8 | 10670 | 2134 | 4268 | 10733 | 2146.6 | 4293.2 | 10796 | 2159.2 | 4318.4 | | | |
| 10608 | 2121.6 | 4243.2 | 10671 | 2134.2 | 4268.4 | 10734 | 2146.8 | 4293.6 | 10797 | 2159.4 | 4318.8 | | | |
| 10609 | 2121.8 | 4243.6 | 10672 | 2134.4 | 4268.8 | 10735 | 2147 | 4294 | 10798 | 2159.6 | 4319.2 | | | |
| 10610 | 2122 | 4244 | 10673 | 2134.6 | 4269.2 | 10736 | 2147.2 | 4294.4 | 10799 | 2159.8 | 4319.6 | | | |
| 10611 | 2122.2 | 4244.4 | 10674 | 2134.8 | 4269.6 | 10737 | 2147.4 | 4294.8 | 10800 | 2160 | 4320 | | | |
| 10612 | 2122.4 | 4244.8 | 10675 | 2135 | 4270 | 10738 | 2147.6 | 4295.2 | 10801 | 2160.2 | 4320.4 | | | |
| 10613 | 2122.6 | 4245.2 | 10676 | 2135.2 | 4270.4 | 10739 | 2147.8 | 4295.6 | 10802 | 2160.4 | 4320.8 | | | |
| 10614 | 2122.8 | 4245.6 | 10677 | 2135.4 | 4270.8 | 10740 | 2148 | 4296 | 10803 | 2160.6 | 4321.2 | | | |
| 10615 | 2123 | 4246 | 10678 | 2135.6 | 4271.2 | 10741 | 2148.2 | 4296.4 | 10804 | 2160.8 | 4321.6 | | | |
| 10616 | 2123.2 | 4246.4 | 10679 | 2135.8 | 4271.6 | 10742 | 2148.4 | 4296.8 | 10805 | 2161 | 4322 | | | |
| 10617 | 2123.4 | 4246.8 | 10680 | 2136 | 4272 | 10743 | 2148.6 | 4297.2 | 10806 | 2161.2 | 4322.4 | | | |
| 10618 | 2123.6 | 4247.2 | 10681 | 2136.2 | 4272.4 | 10744 | 2148.8 | 4297.6 | 10807 | 2161.4 | 4322.8 | | | |
| 10619 | 2123.8 | 4247.6 | 10682 | 2136.4 | 4272.8 | 10745 | 2149 | 4298 | 10808 | 2161.6 | 4323.2 | | | |
| 10620 | 2124 | 4248 | 10683 | 2136.6 | 4273.2 | 10746 | 2149.2 | 4298.4 | 10809 | 2161.8 | 4323.6 | | | |
| 10621 | 2124.2 | 4248.4 | 10684 | 2136.8 | 4273.6 | 10747 | 2149.4 | 4298.8 | 10810 | 2162 | 4324 | | | |
| 10622 | 2124.4 | 4248.8 | 10685 | 2137 | 4274 | 10748 | 2149.6 | 4299.2 | 10811 | 2162.2 | 4324.4 | | | |
| 10623 | 2124.6 | 4249.2 | 10686 | 2137.2 | 4274.4 | 10749 | 2149.8 | 4299.6 | 10812 | 2162.4 | 4324.8 | | | |
| 10624 | 2124.8 | 4249.6 | 10687 | 2137.4 | 4274.8 | 10750 | 2150 | 4300 | 10813 | 2162.6 | 4325.2 | | | |


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## WCDMA 2100 Tx frequencies

| Ch | Tx | VCO Tx | Ch | Tx | VCO Tx | Ch | Tx | VCO Tx | Ch | Tx | VCO Tx | Ch | Tx | VCO Tx |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 9612 | 1922.4 | 3844.8 | 9671 | 1934.2 | 3868.4 | 9730 | 1946 | 3892 | 9789 | 1957.8 | 3915.6 | 9848 | 1969.6 | 3939.2 |
| 9613 | 1922.6 | 3845.2 | 9672 | 1934.4 | 3868.8 | 9731 | 1946.2 | 3892.4 | 9790 | 1958 | 3916 | 9849 | 1969.8 | 3939.6 |
| 9614 | 1922.8 | 3845.6 | 9673 | 1934.6 | 3869.2 | 9732 | 1946.4 | 3892.8 | 9791 | 1958.2 | 3916.4 | 9850 | 1970 | 3940 |
| 9615 | 1923 | 3846 | 9674 | 1934.8 | 3869.6 | 9733 | 1946.6 | 3893.2 | 9792 | 1958.4 | 3916.8 | 9851 | 1970.2 | 3940.4 |
| 9616 | 1923.2 | 3846.4 | 9675 | 1935 | 3870 | 9734 | 1946.8 | 3893.6 | 9793 | 1958.6 | 3917.2 | 9852 | 1970.4 | 3940.8 |
| 9617 | 1923.4 | 3846.8 | 9676 | 1935.2 | 3870.4 | 9735 | 1947 | 3894 | 9794 | 1958.8 | 3917.6 | 9853 | 1970.6 | 3941.2 |
| 9618 | 1923.6 | 3847.2 | 9677 | 1935.4 | 3870.8 | 9736 | 1947.2 | 3894.4 | 9795 | 1959 | 3918 | 9854 | 1970.8 | 3941.6 |
| 9619 | 1923.8 | 3847.6 | 9678 | 1935.6 | 3871.2 | 9737 | 1947.4 | 3894.8 | 9796 | 1959.2 | 3918.4 | 9855 | 1971 | 3942 |
| 9620 | 1924 | 3848 | 9679 | 1935.8 | 3871.6 | 9738 | 1947.6 | 3895.2 | 9797 | 1959.4 | 3918.8 | 9856 | 1971.2 | 3942.4 |
| 9621 | 1924.2 | 3848.4 | 9680 | 1936 | 3872 | 9739 | 1947.8 | 3895.6 | 9798 | 1959.6 | 3919.2 | 9857 | 1971.4 | 3942.8 |
| 9622 | 1924.4 | 3848.8 | 9681 | 1936.2 | 3872.4 | 9740 | 1948 | 3896 | 9799 | 1959.8 | 3919.6 | 9858 | 1971.6 | 3943.2 |
| 9623 | 1924.6 | 3849.2 | 9682 | 1936.4 | 3872.8 | 9741 | 1948.2 | 3896.4 | 9800 | 1960 | 3920 | 9859 | 1971.8 | 3943.6 |
| 9624 | 1924.8 | 3849.6 | 9683 | 1936.6 | 3873.2 | 9742 | 1948.4 | 3896.8 | 9801 | 1960.2 | 3920.4 | 9860 | 1972 | 3944 |
| 9625 | 1925 | 3850 | 9684 | 1936.8 | 3873.6 | 9743 | 1948.6 | 3897.2 | 9802 | 1960.4 | 3920.8 | 9861 | 1972.2 | 3944.4 |
| 9626 | 1925.2 | 3850.4 | 9685 | 1937 | 3874 | 9744 | 1948.8 | 3897.6 | 9803 | 1960.6 | 3921.2 | 9862 | 1972.4 | 3944.8 |
| 9627 | 1925.4 | 3850.8 | 9686 | 1937.2 | 3874.4 | 9745 | 1949 | 3898 | 9804 | 1960.8 | 3921.6 | 9863 | 1972.6 | 3945.2 |
| 9628 | 1925.6 | 3851.2 | 9687 | 1937.4 | 3874.8 | 9746 | 1949.2 | 3898.4 | 9805 | 1961 | 3922 | 9864 | 1972.8 | 3945.6 |
| 9629 | 1925.8 | 3851.6 | 9688 | 1937.6 | 3875.2 | 9747 | 1949.4 | 3898.8 | 9806 | 1961.2 | 3922.4 | 9865 | 1973 | 3946 |
| 9630 | 1926 | 3852 | 9689 | 1937.8 | 3875.6 | 9748 | 1949.6 | 3899.2 | 9807 | 1961.4 | 3922.8 | 9866 | 1973.2 | 3946.4 |
| 9631 | 1926.2 | 3852.4 | 9690 | 1938 | 3876 | 9749 | 1949.8 | 3899.6 | 9808 | 1961.6 | 3923.2 | 9867 | 1973.4 | 3946.8 |
| 9632 | 1926.4 | 3852.8 | 9691 | 1938.2 | 3876.4 | 9750 | 1950 | 3900 | 9809 | 1961.8 | 3923.6 | 9868 | 1973.6 | 3947.2 |
| 9633 | 1926.6 | 3853.2 | 9692 | 1938.4 | 3876.8 | 9751 | 1950.2 | 3900.4 | 9810 | 1962 | 3924 | 9869 | 1973.8 | 3947.6 |
| 9634 | 1926.8 | 3853.6 | 9693 | 1938.6 | 3877.2 | 9752 | 1950.4 | 3900.8 | 9811 | 1962.2 | 3924.4 | 9870 | 1974 | 3948 |
| 9635 | 1927 | 3854 | 9694 | 1938.8 | 3877.6 | 9753 | 1950.6 | 3901.2 | 9812 | 1962.4 | 3924.8 | 9871 | 1974.2 | 3948.4 |
| 9636 | 1927.2 | 3854.4 | 9695 | 1939 | 3878 | 9754 | 1950.8 | 3901.6 | 9813 | 1962.6 | 3925.2 | 9872 | 1974.4 | 3948.8 |
| 9637 | 1927.4 | 3854.8 | 9696 | 1939.2 | 3878.4 | 9755 | 1951 | 3902 | 9814 | 1962.8 | 3925.6 | 9873 | 1974.6 | 3949.2 |
| 9638 | 1927.6 | 3855.2 | 9697 | 1939.4 | 3878.8 | 9756 | 1951.2 | 3902.4 | 9815 | 1963 | 3926 | 9874 | 1974.8 | 3949.6 |
| 9639 | 1927.8 | 3855.6 | 9698 | 1939.6 | 3879.2 | 9757 | 1951.4 | 3902.8 | 9816 | 1963.2 | 3926.4 | 9875 | 1975 | 3950 |
| 9640 | 1928 | 3856 | 9699 | 1939.8 | 3879.6 | 9758 | 1951.6 | 3903.2 | 9817 | 1963.4 | 3926.8 | 9876 | 1975.2 | 3950.4 |
| 9641 | 1928.2 | 3856.4 | 9700 | 1940 | 3880 | 9759 | 1951.8 | 3903.6 | 9818 | 1963.6 | 3927.2 | 9877 | 1975.4 | 3950.8 |
| 9642 | 1928.4 | 3856.8 | 9701 | 1940.2 | 3880.4 | 9760 | 1952 | 3904 | 9819 | 1963.8 | 3927.6 | 9878 | 1975.6 | 3951.2 |
| 9643 | 1928.6 | 3857.2 | 9702 | 1940.4 | 3880.8 | 9761 | 1952.2 | 3904.4 | 9820 | 1964 | 3928 | 9879 | 1975.8 | 3951.6 |
| 9644 | 1928.8 | 3857.6 | 9703 | 1940.6 | 3881.2 | 9762 | 1952.4 | 3904.8 | 9821 | 1964.2 | 3928.4 | 9880 | 1976 | 3952 |
| 9645 | 1929 | 3858 | 9704 | 1940.8 | 3881.6 | 9763 | 1952.6 | 3905.2 | 9822 | 1964.4 | 3928.8 | 9881 | 1976.2 | 3952.4 |
| 9646 | 1929.2 | 3858.4 | 9705 | 1941 | 3882 | 9764 | 1952.8 | 3905.6 | 9823 | 1964.6 | 3929.2 | 9882 | 1976.4 | 3952.8 |
| 9647 | 1929.4 | 3858.8 | 9706 | 1941.2 | 3882.4 | 9765 | 1953 | 3906 | 9824 | 1964.8 | 3929.6 | 9883 | 1976.6 | 3953.2 |
| 9648 | 1929.6 | 3859.2 | 9707 | 1941.4 | 3882.8 | 9766 | 1953.2 | 3906.4 | 9825 | 1965 | 3930 | 9884 | 1976.8 | 3953.6 |
| 9649 | 1929.8 | 3859.6 | 9708 | 1941.6 | 3883.2 | 9767 | 1953.4 | 3906.8 | 9826 | 1965.2 | 3930.4 | 9885 | 1977 | 3954 |
| 9650 | 1930 | 3860 | 9709 | 1941.8 | 3883.6 | 9768 | 1953.6 | 3907.2 | 9827 | 1965.4 | 3930.8 | 9886 | 1977.2 | 3954.4 |
| 9651 | 1930.2 | 3860.4 | 9710 | 1942 | 3884 | 9769 | 1953.8 | 3907.6 | 9828 | 1965.6 | 3931.2 | 9887 | 1977.4 | 3954.8 |
| 9652 | 1930.4 | 3860.8 | 9711 | 1942.2 | 3884.4 | 9770 | 1954 | 3908 | 9829 | 1965.8 | 3931.6 | 9888 | 1977.6 | 3955.2 |
| 9653 | 1930.6 | 3861.2 | 9712 | 1942.4 | 3884.8 | 9771 | 1954.2 | 3908.4 | 9830 | 1966 | 3932 | | | |
| 9654 | 1930.8 | 3861.6 | 9713 | 1942.6 | 3885.2 | 9772 | 1954.4 | 3908.8 | 9831 | 1966.2 | 3932.4 | | | |
| 9655 | 1931 | 3862 | 9714 | 1942.8 | 3885.6 | 9773 | 1954.6 | 3909.2 | 9832 | 1966.4 | 3932.8 | | | |
| 9656 | 1931.2 | 3862.4 | 9715 | 1943 | 3886 | 9774 | 1954.8 | 3909.6 | 9833 | 1966.6 | 3933.2 | | | |
| 9657 | 1931.4 | 3862.8 | 9716 | 1943.2 | 3886.4 | 9775 | 1955 | 3910 | 9834 | 1966.8 | 3933.6 | | | |
| 9658 | 1931.6 | 3863.2 | 9717 | 1943.4 | 3886.8 | 9776 | 1955.2 | 3910.4 | 9835 | 1967 | 3934 | | | |
| 9659 | 1931.8 | 3863.6 | 9718 | 1943.6 | 3887.2 | 9777 | 1955.4 | 3910.8 | 9836 | 1967.2 | 3934.4 | | | |
| 9660 | 1932 | 3864 | 9719 | 1943.8 | 3887.6 | 9778 | 1955.6 | 3911.2 | 9837 | 1967.4 | 3934.8 | | | |
| 9661 | 1932.2 | 3864.4 | 9720 | 1944 | 3888 | 9779 | 1955.8 | 3911.6 | 9838 | 1967.6 | 3935.2 | | | |
| 9662 | 1932.4 | 3864.8 | 9721 | 1944.2 | 3888.4 | 9780 | 1956 | 3912 | 9839 | 1967.8 | 3935.6 | | | |
| 9663 | 1932.6 | 3865.2 | 9722 | 1944.4 | 3888.8 | 9781 | 1956.2 | 3912.4 | 9840 | 1968 | 3936 | | | |
| 9664 | 1932.8 | 3865.6 | 9723 | 1944.6 | 3889.2 | 9782 | 1956.4 | 3912.8 | 9841 | 1968.2 | 3936.4 | | | |
| 9665 | 1933 | 3866 | 9724 | 1944.8 | 3889.6 | 9783 | 1956.6 | 3913.2 | 9842 | 1968.4 | 3936.8 | | | |
| 9666 | 1933.2 | 3866.4 | 9725 | 1945 | 3890 | 9784 | 1956.8 | 3913.6 | 9843 | 1968.6 | 3937.2 | | | |
| 9667 | 1933.4 | 3866.8 | 9726 | 1945.2 | 3890.4 | 9785 | 1957 | 3914 | 9844 | 1968.8 | 3937.6 | | | |
| 9668 | 1933.6 | 3867.2 | 9727 | 1945.4 | 3890.8 | 9786 | 1957.2 | 3914.4 | 9845 | 1969 | 3938 | | | |
| 9669 | 1933.8 | 3867.6 | 9728 | 1945.6 | 3891.2 | 9787 | 1957.4 | 3914.8 | 9846 | 1969.2 | 3938.4 | | | |
| 9670 | 1934 | 3868 | 9729 | 1945.8 | 3891.6 | 9788 | 1957.6 | 3915.2 | 9847 | 1969.4 | 3938.8 | | | |


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# 11 — Schematics


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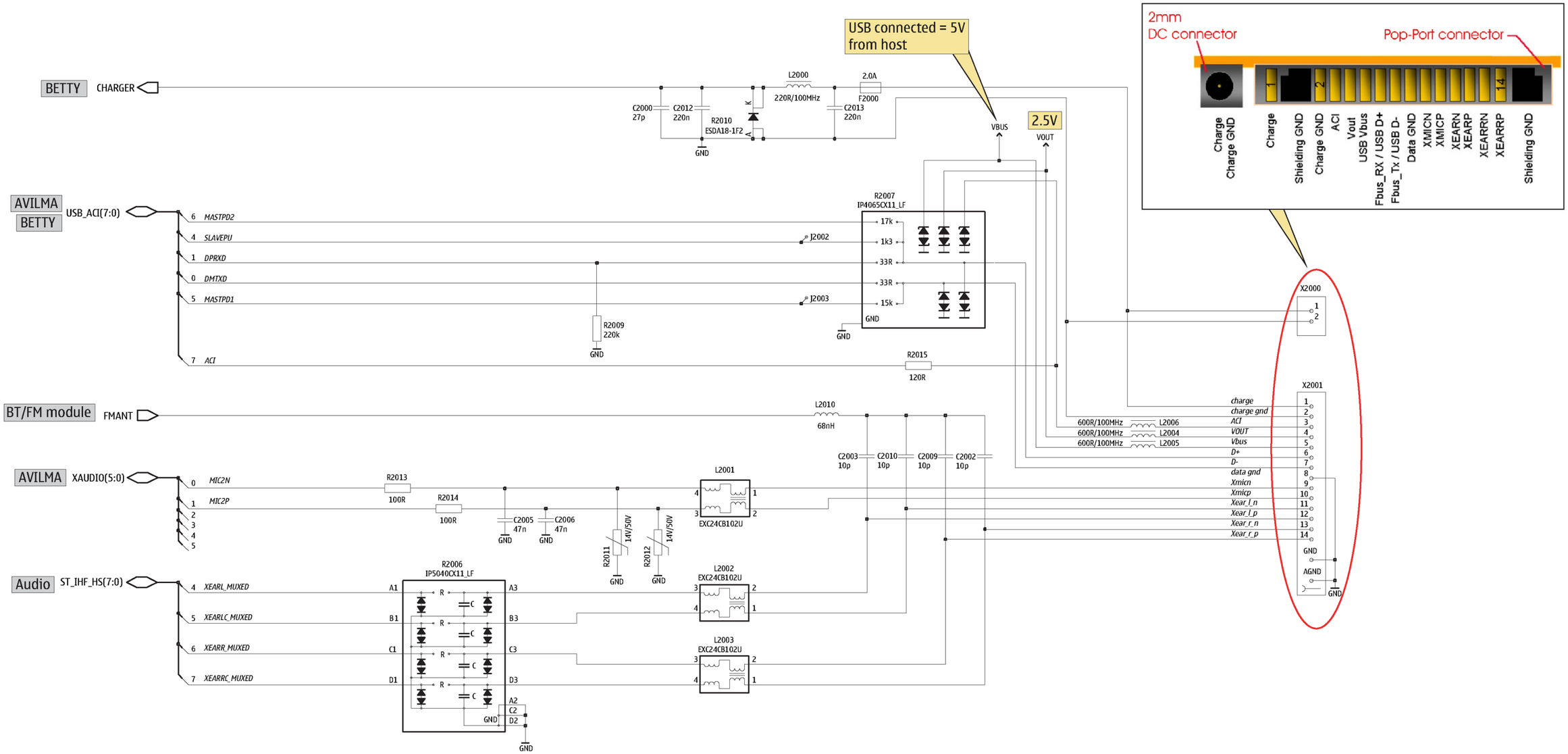
## System connector





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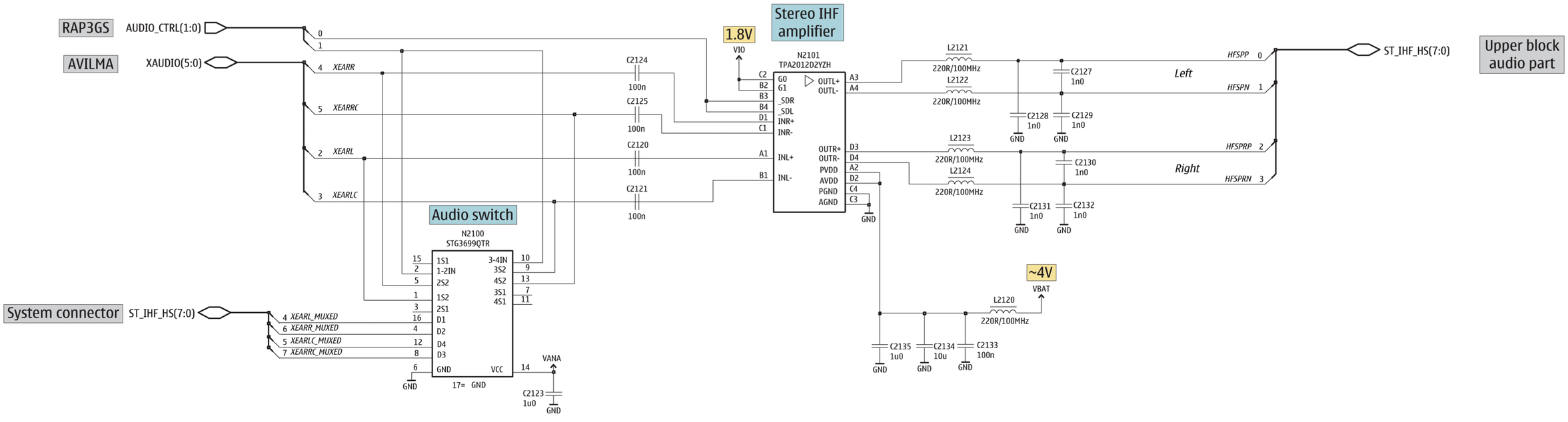
## Audio





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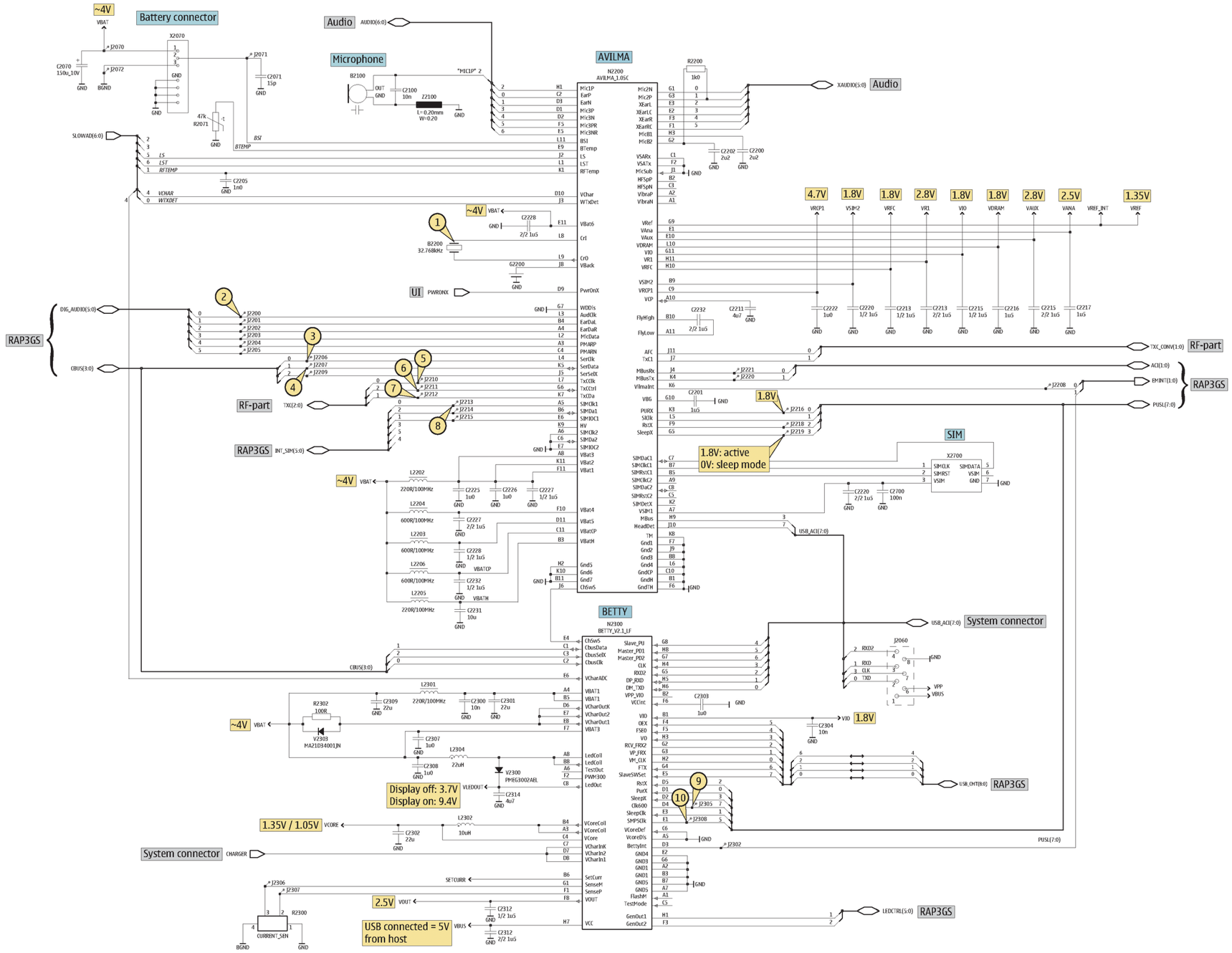
## AVILMA & BETTY





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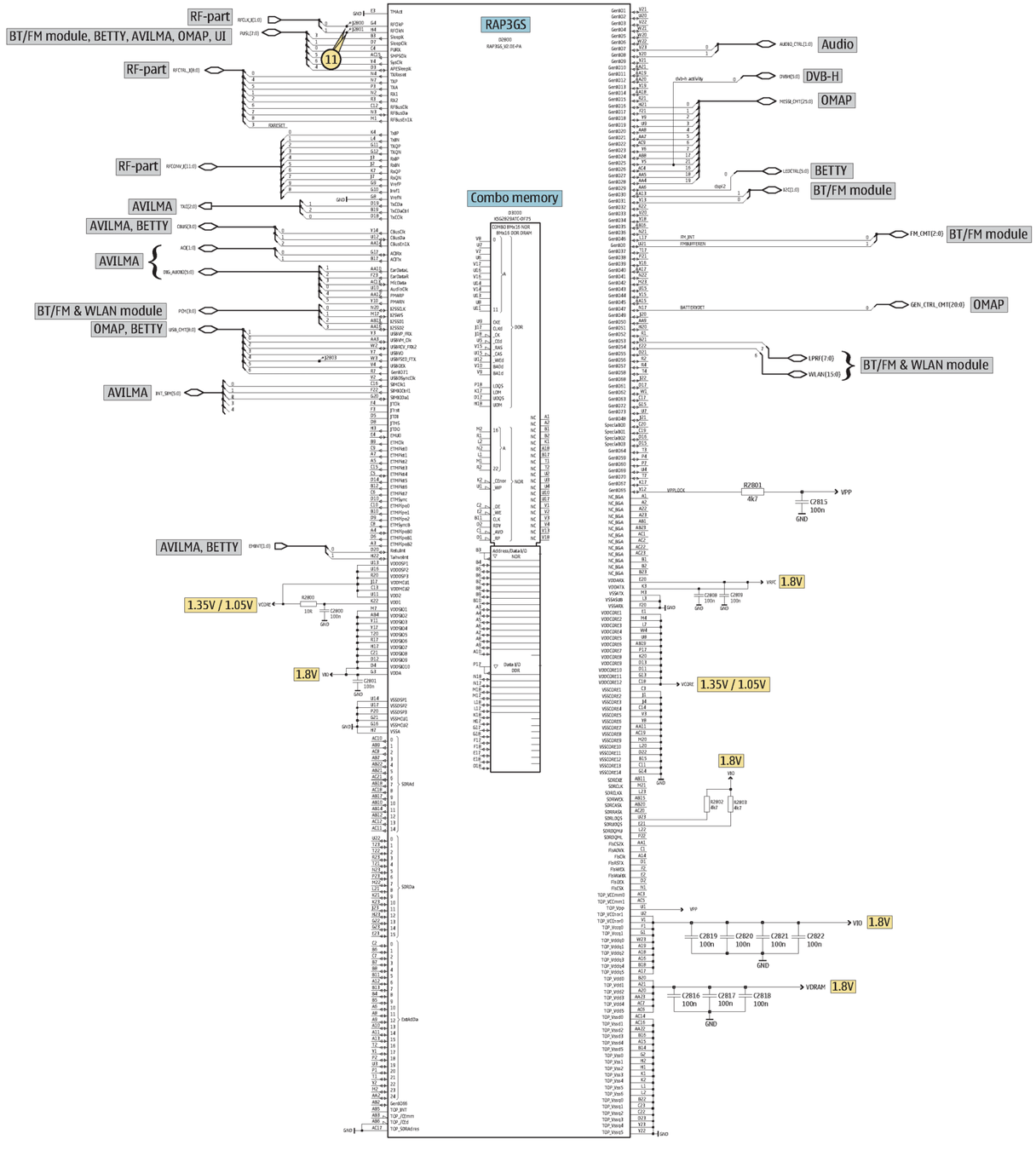
## RAP3GS





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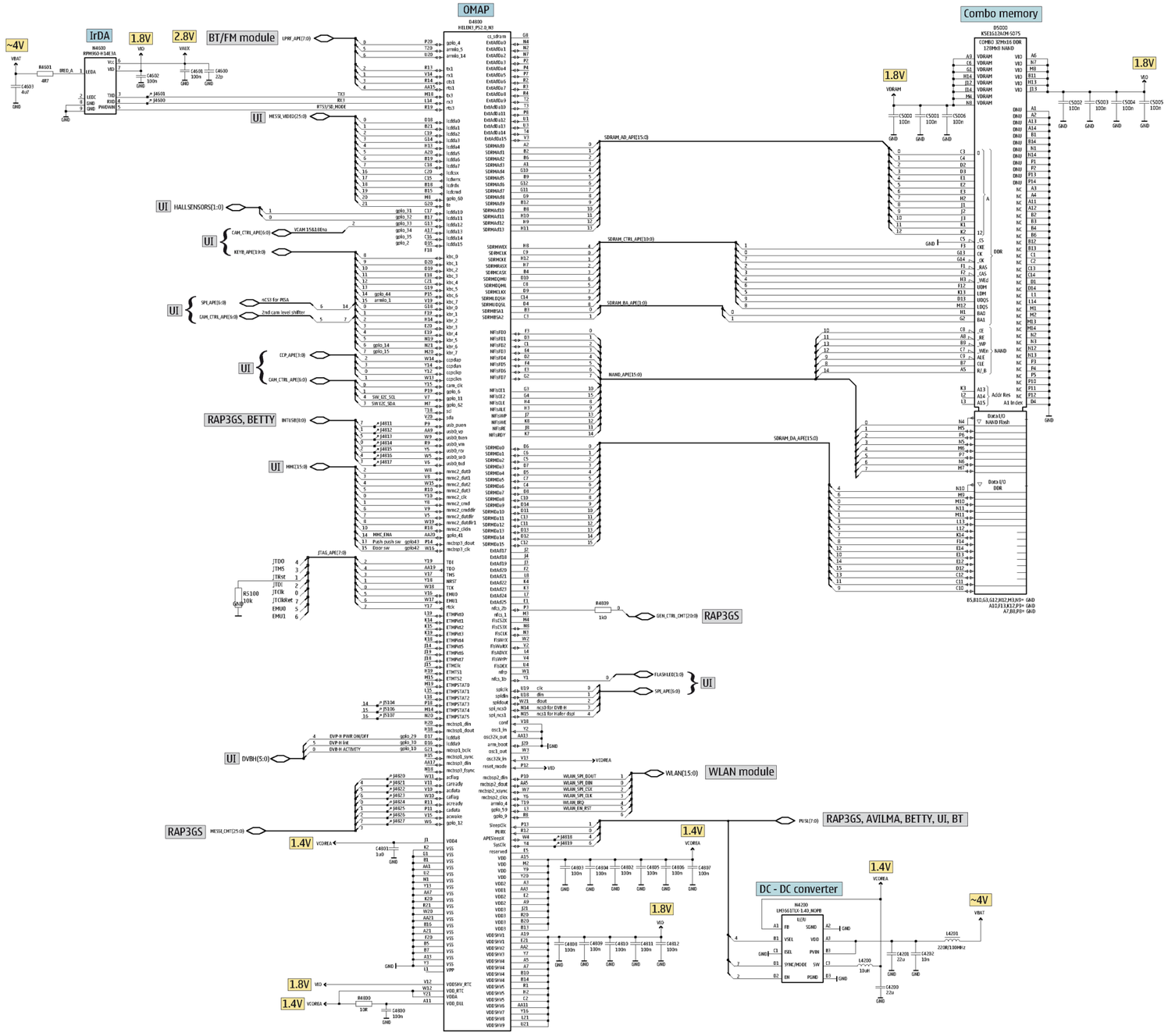
## OMAP and combo memory





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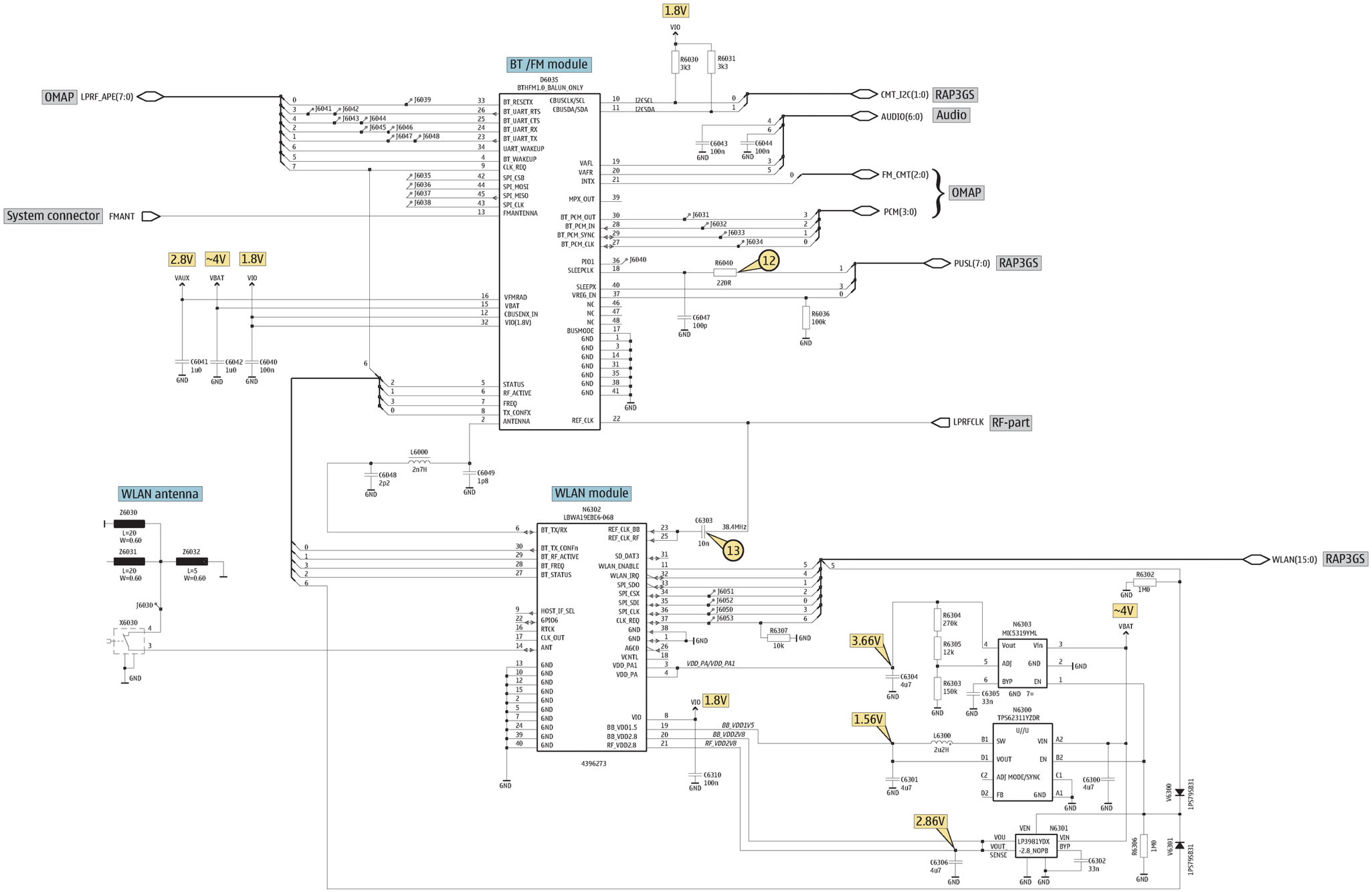
## BT/FM and WLAN modules





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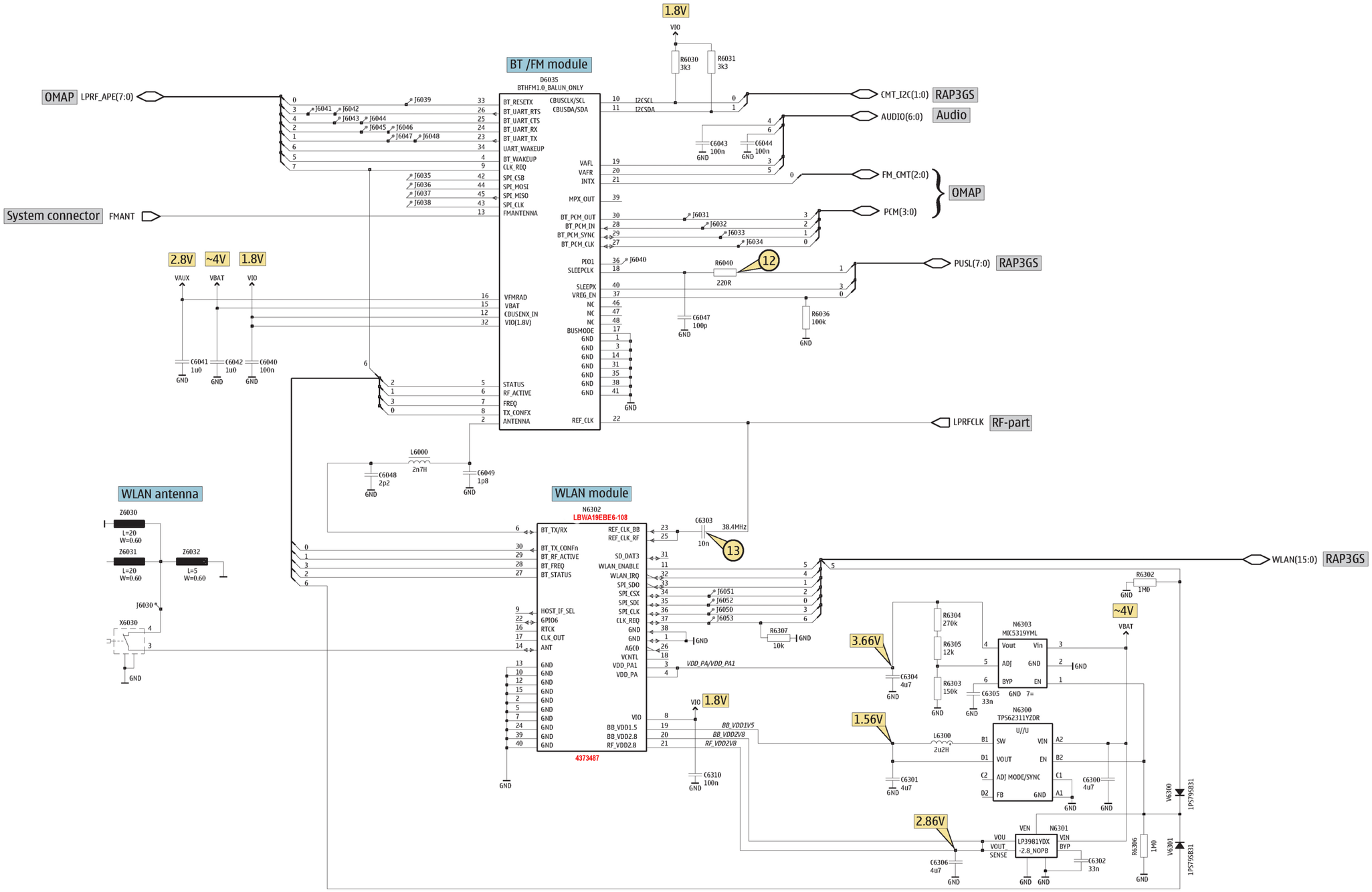
## BT/FM and WLAN modules - changes to HWID 1500





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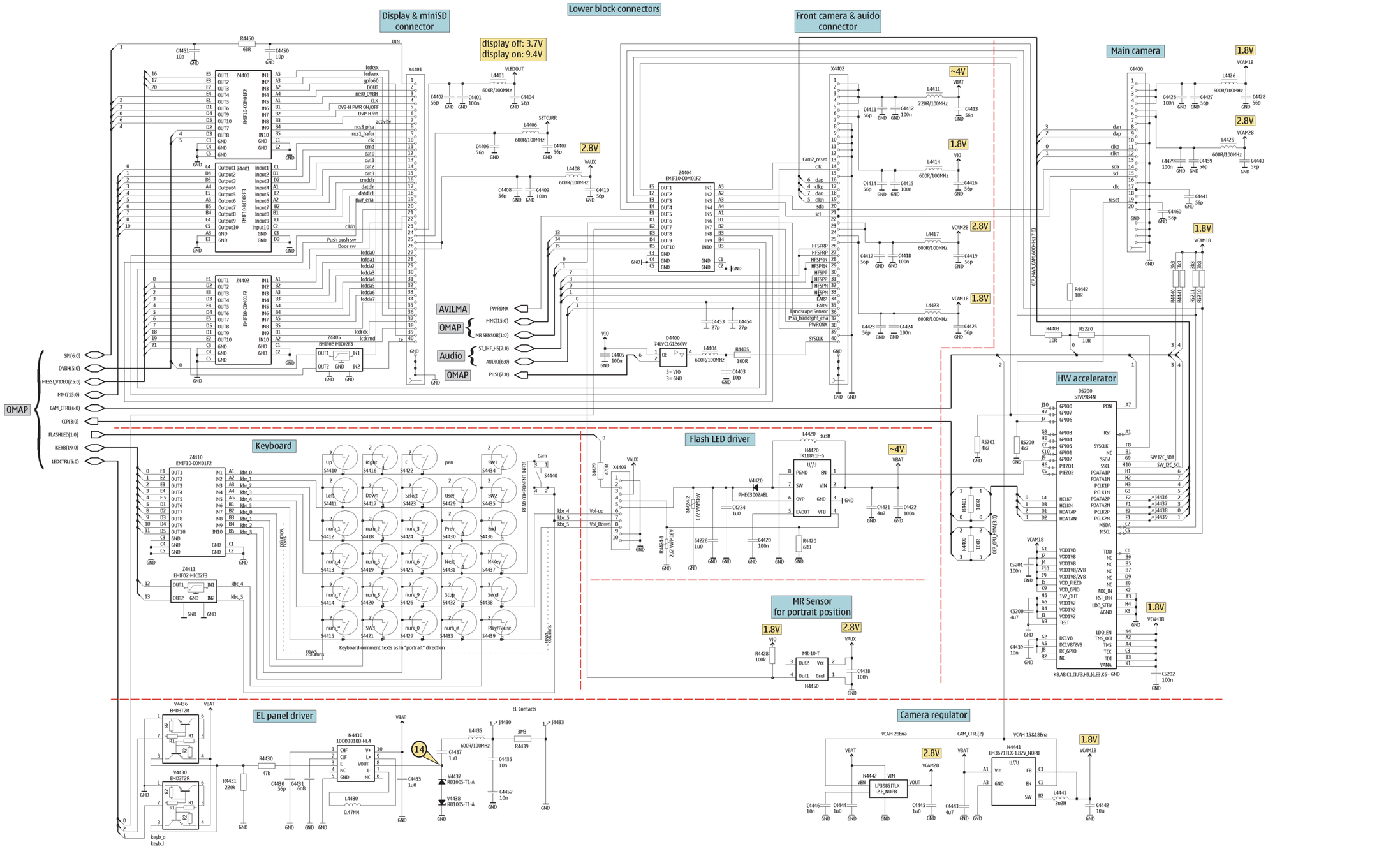
## User interface





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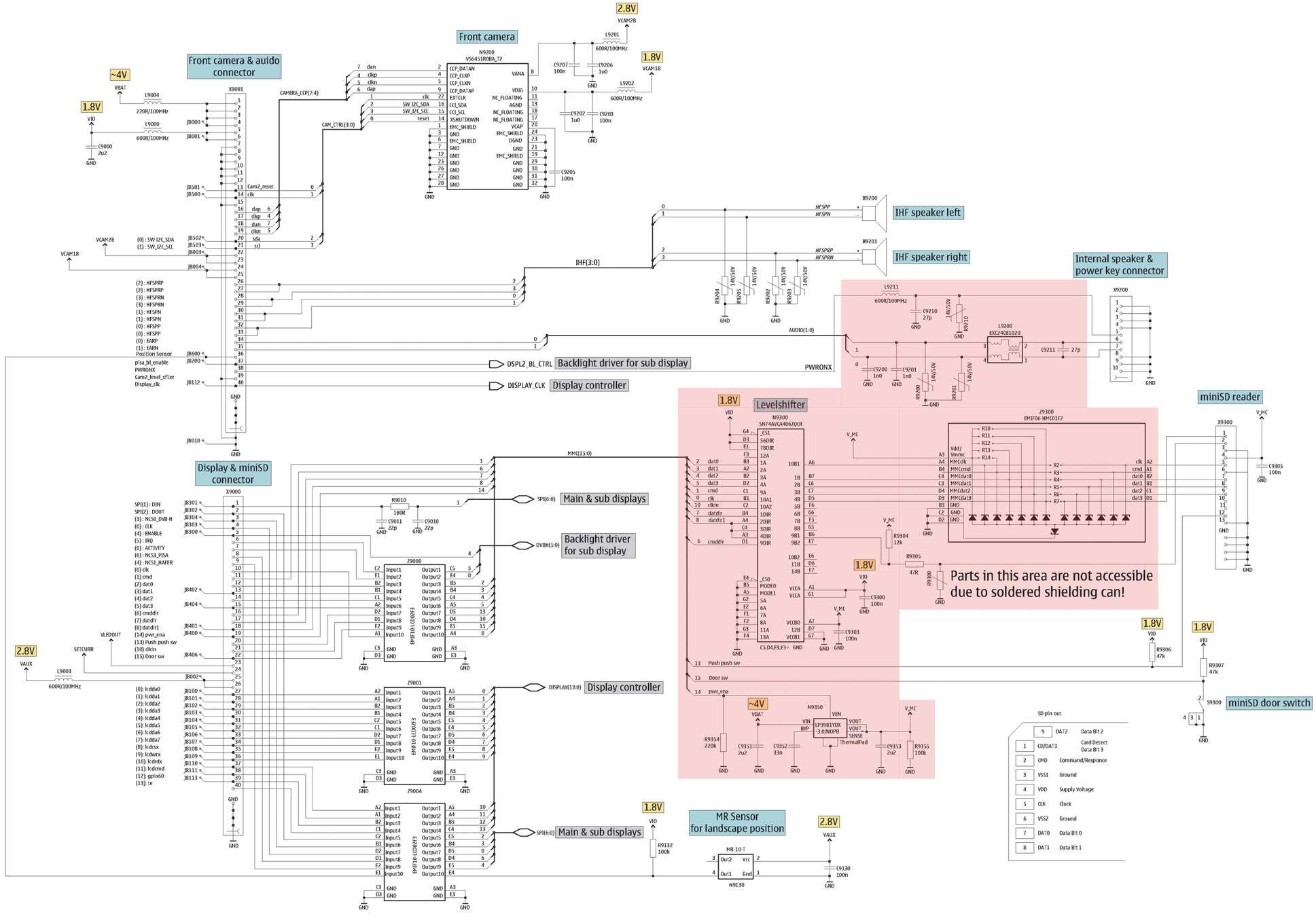
## Upper block / connectors, audio and MMC





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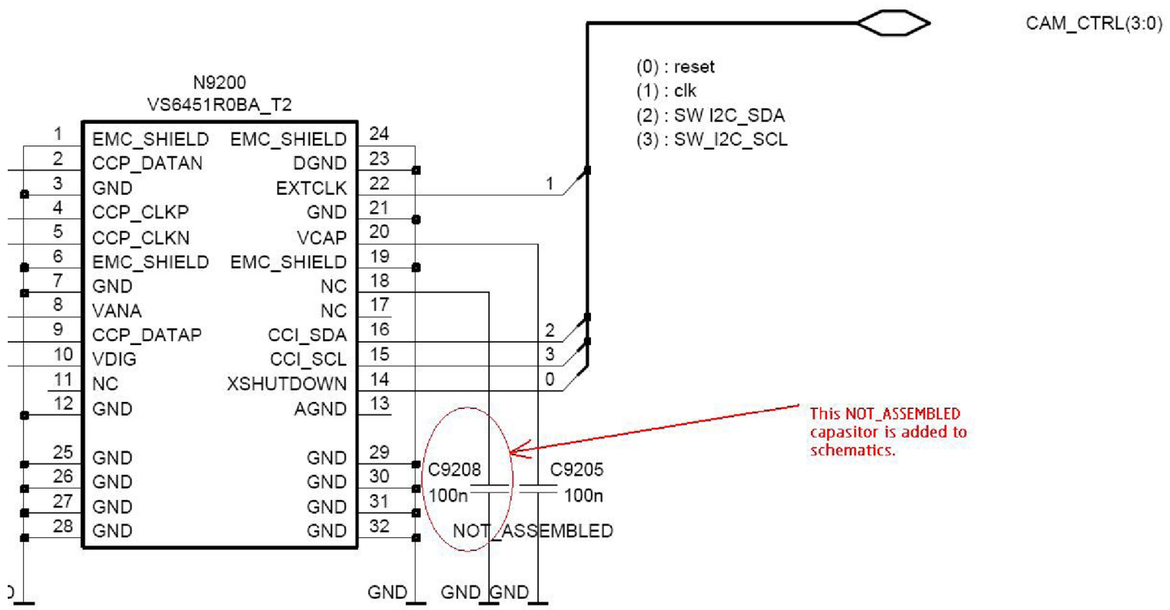
## Upper block/connectors, audio and MMC- changes to HWID 1500

### Front camera part





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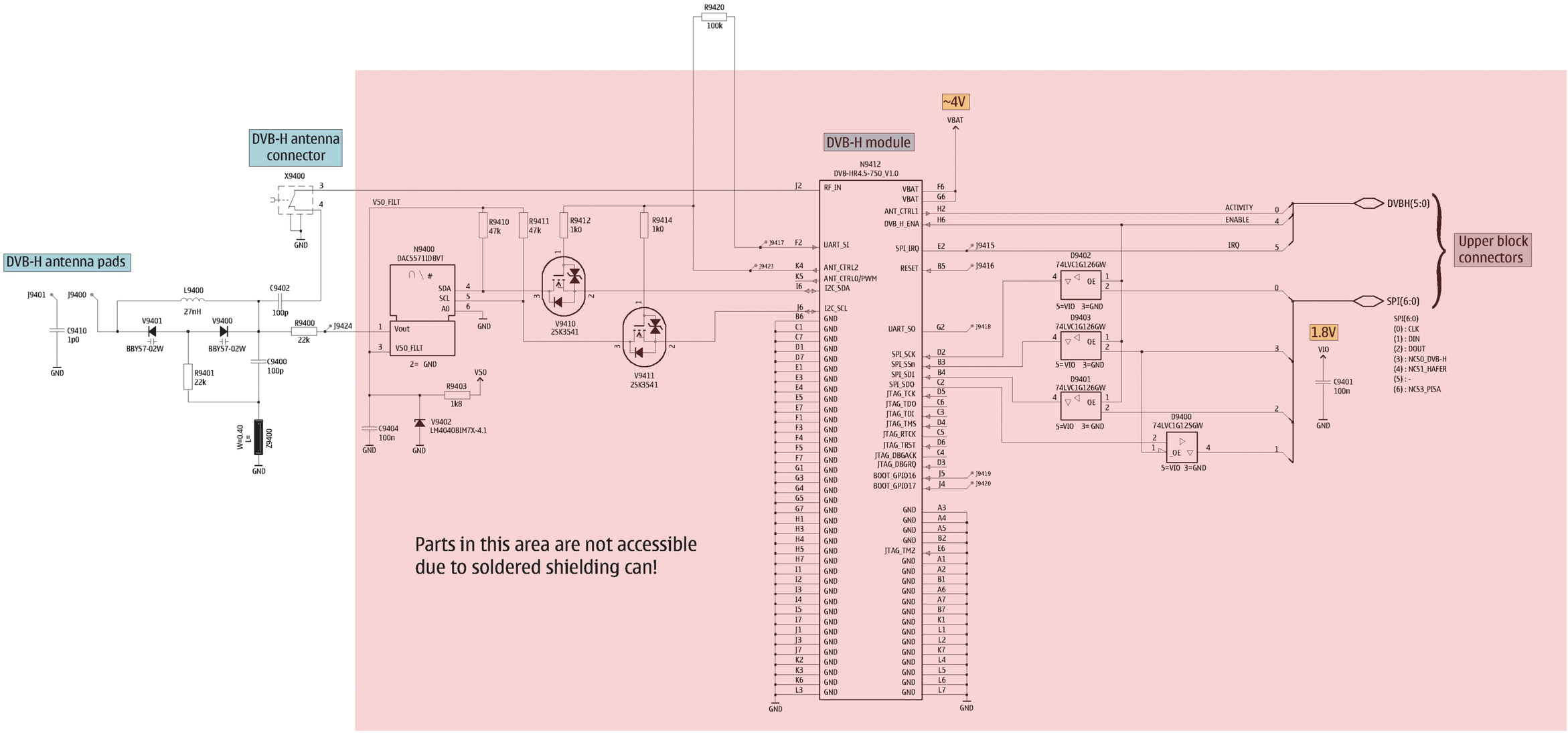
## Upper block / DVB-H part





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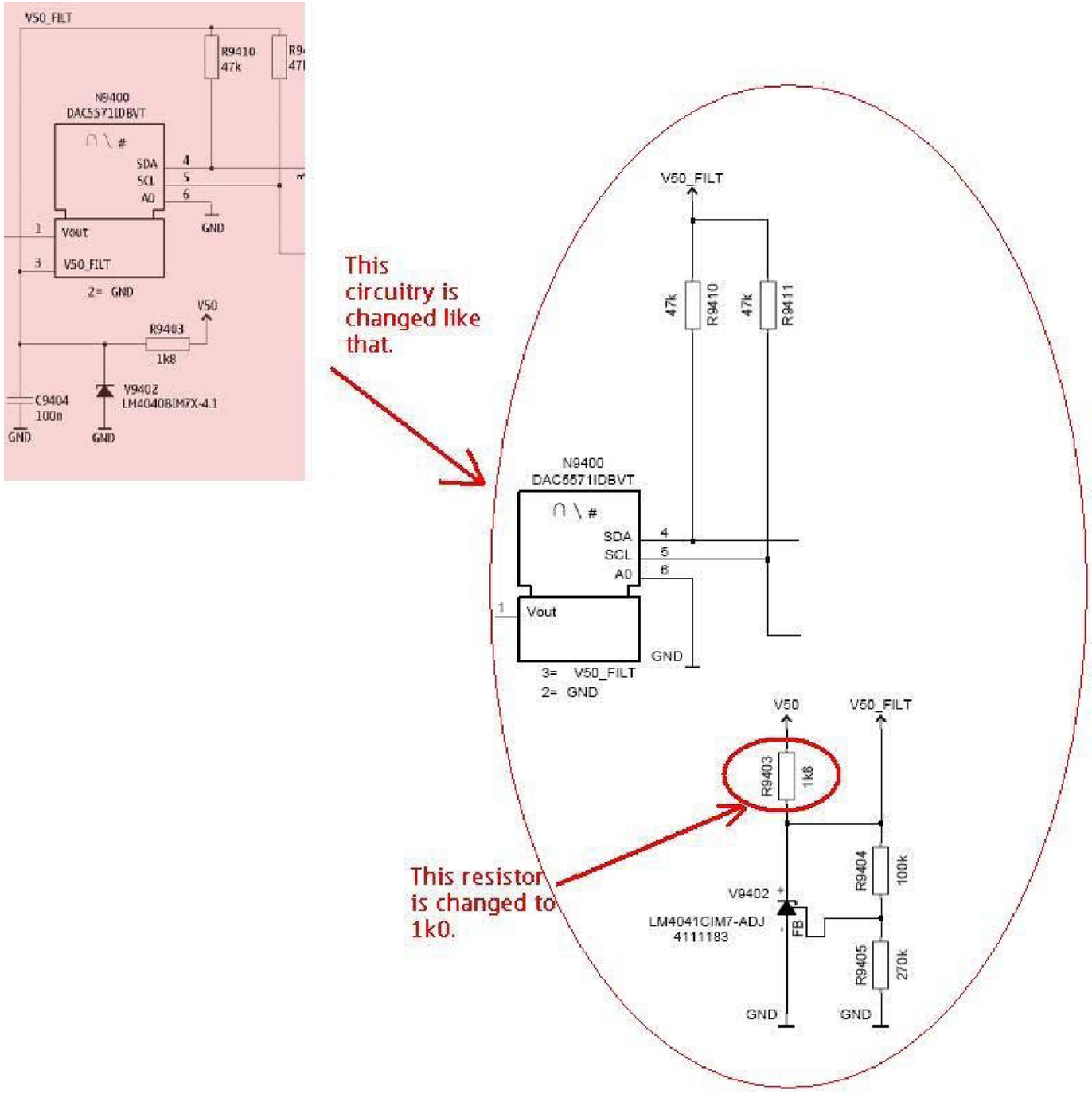
## Upper block/DVB-H-changes to HWID 1500





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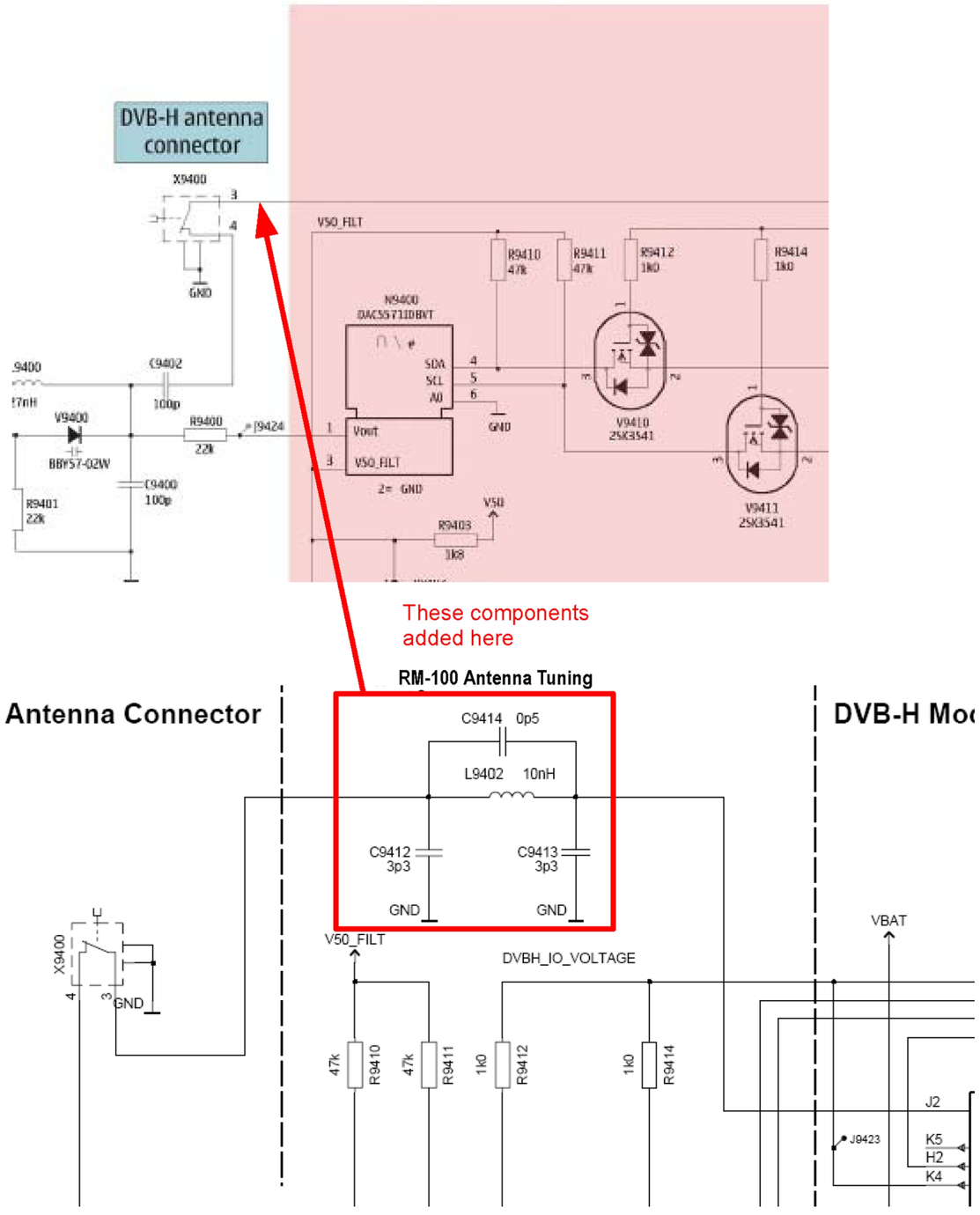



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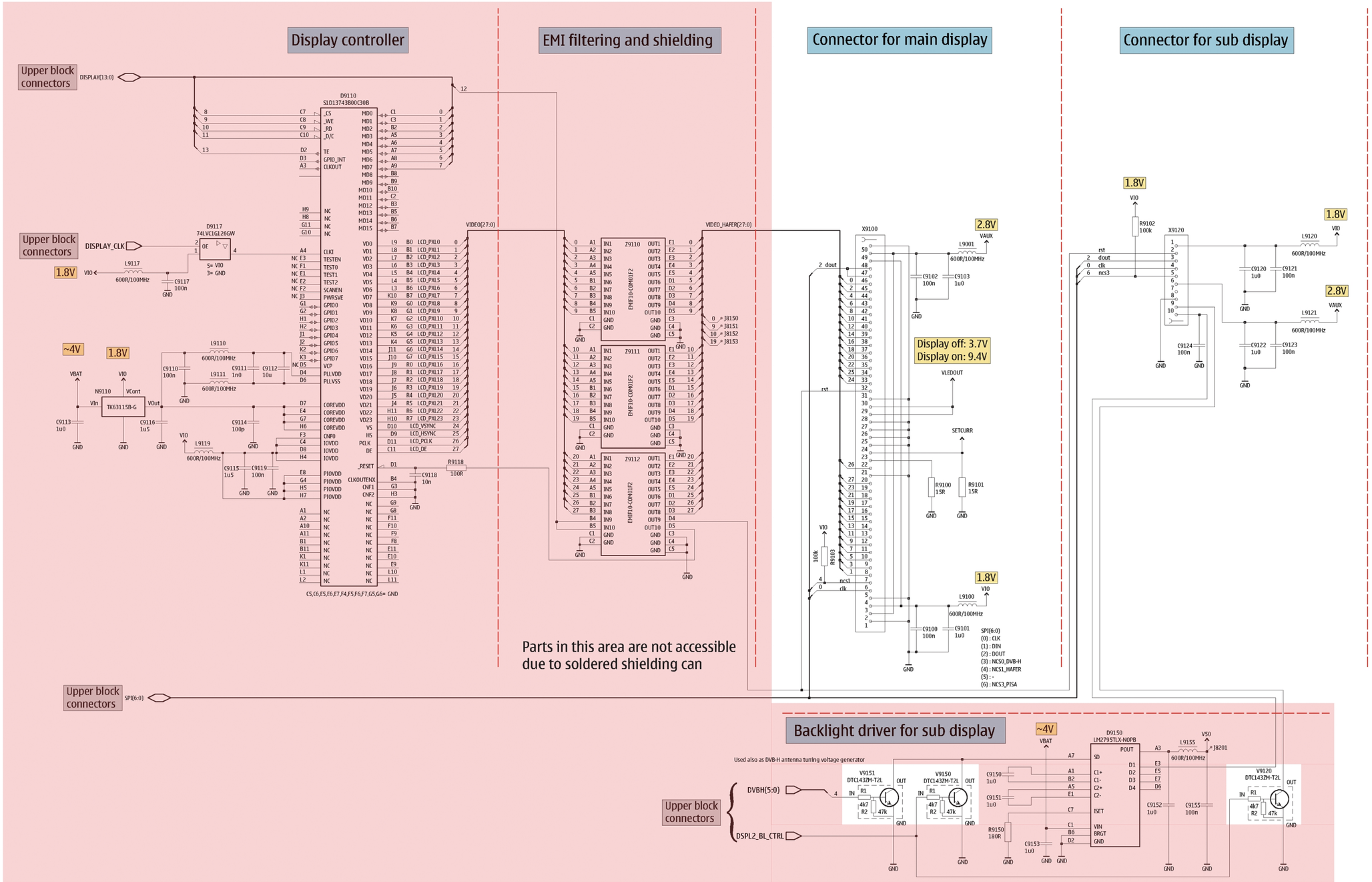
## Upper block / display





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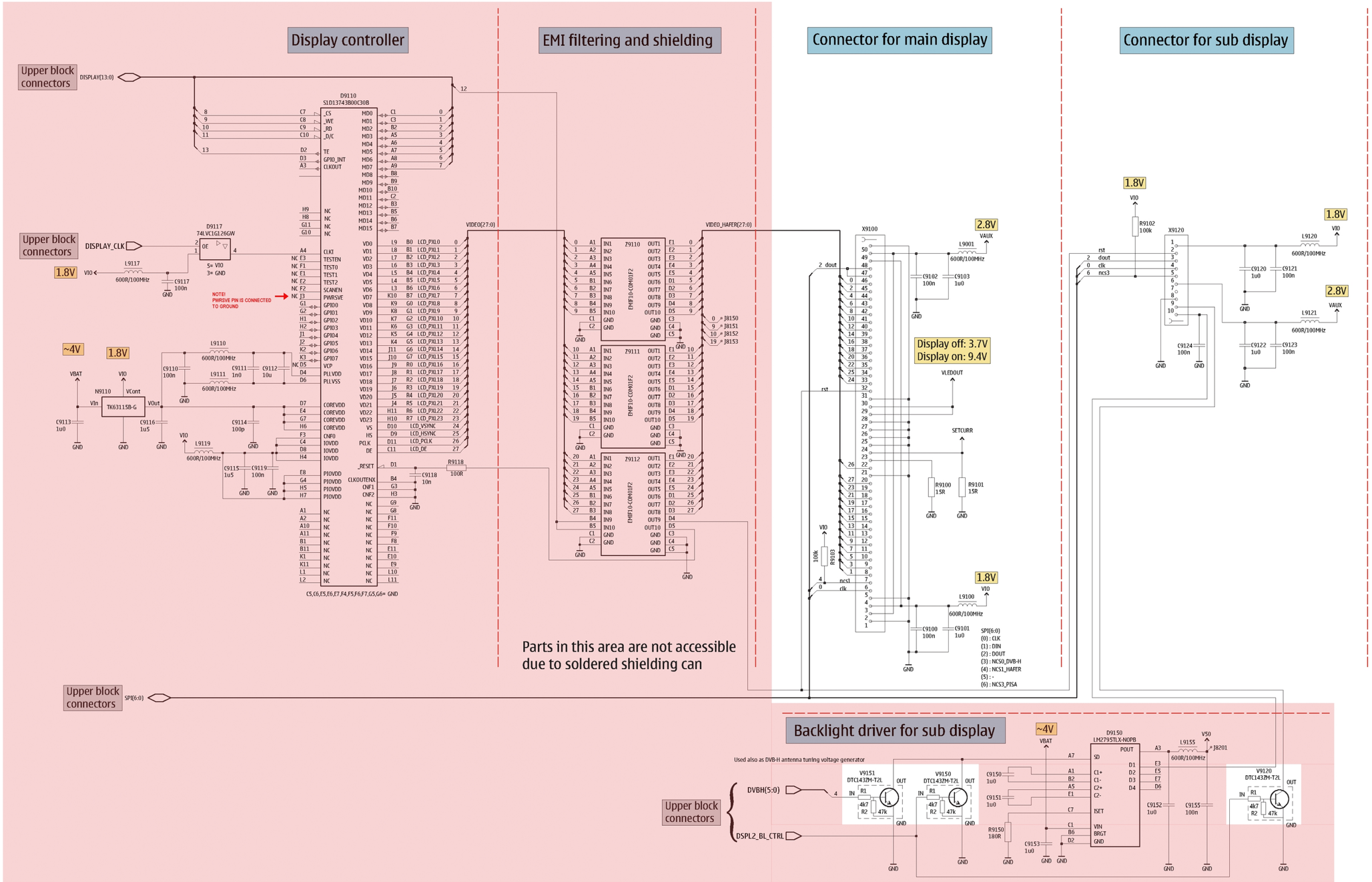
## Upper block/display -changes to HWID 1500





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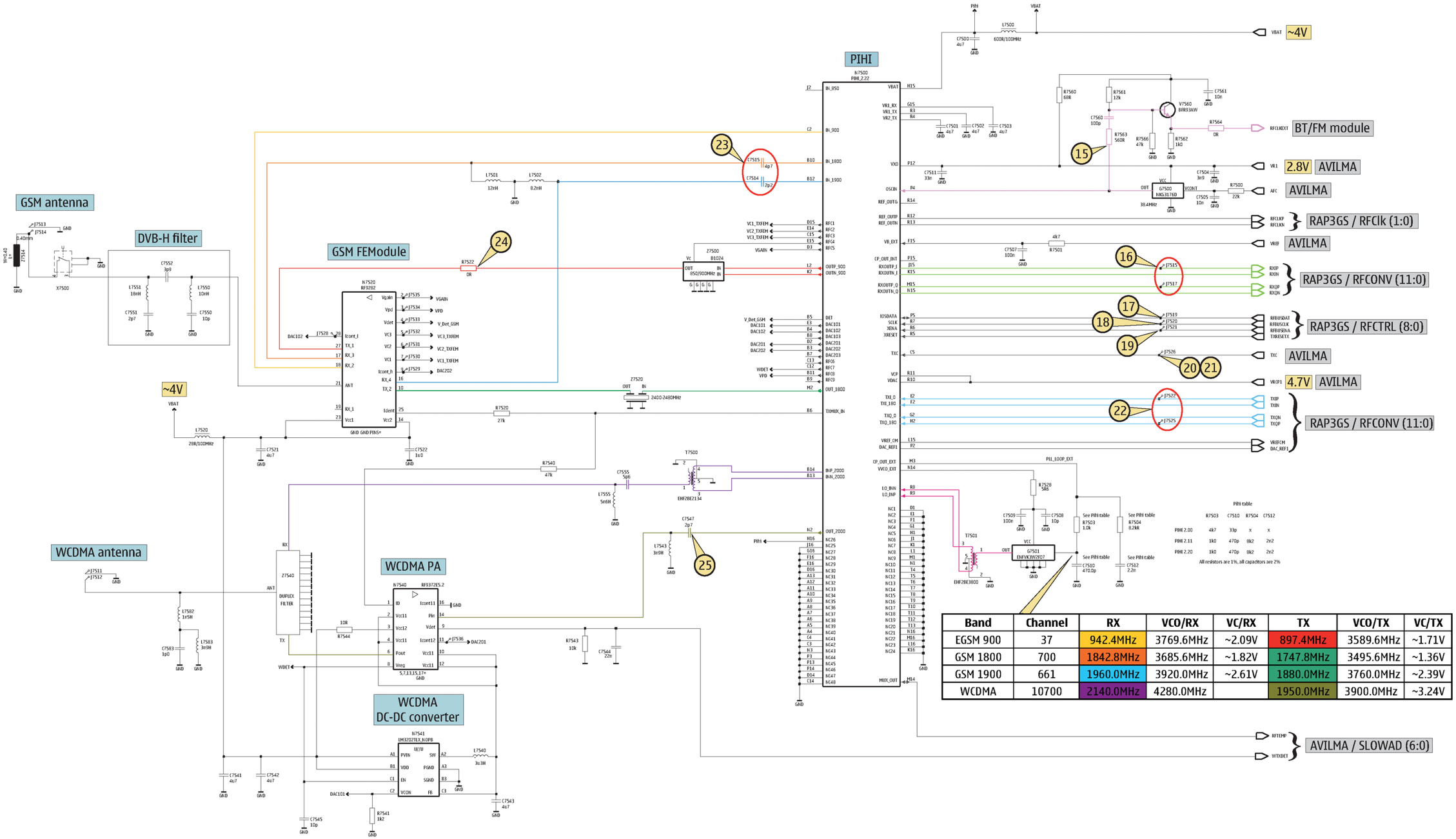
## RF part




| Band | Channel | RX | VCO/RX | VC/RX | TX | VCO/TX | VC/TX |
|---|---|---|---|---|---|---|---|
| EGSM 900 | 37 | 942.4MHz | 3769.6MHz | ~2.09V | 897.4MHz | 3589.6MHz | ~1.71V |
| GSM 1800 | 700 | 1842.8MHz | 3685.6MHz | ~1.82V | 1747.8MHz | 3495.6MHz | ~1.36V |
| GSM 1900 | 661 | 1960.0MHz | 3920.0MHz | ~2.61V | 1880.0MHz | 3760.0MHz | ~2.39V |
| WCDMA | 10700 | 2140.0MHz | 4280.0MHz | | 1950.0MHz | 3900.0MHz | ~3.24V |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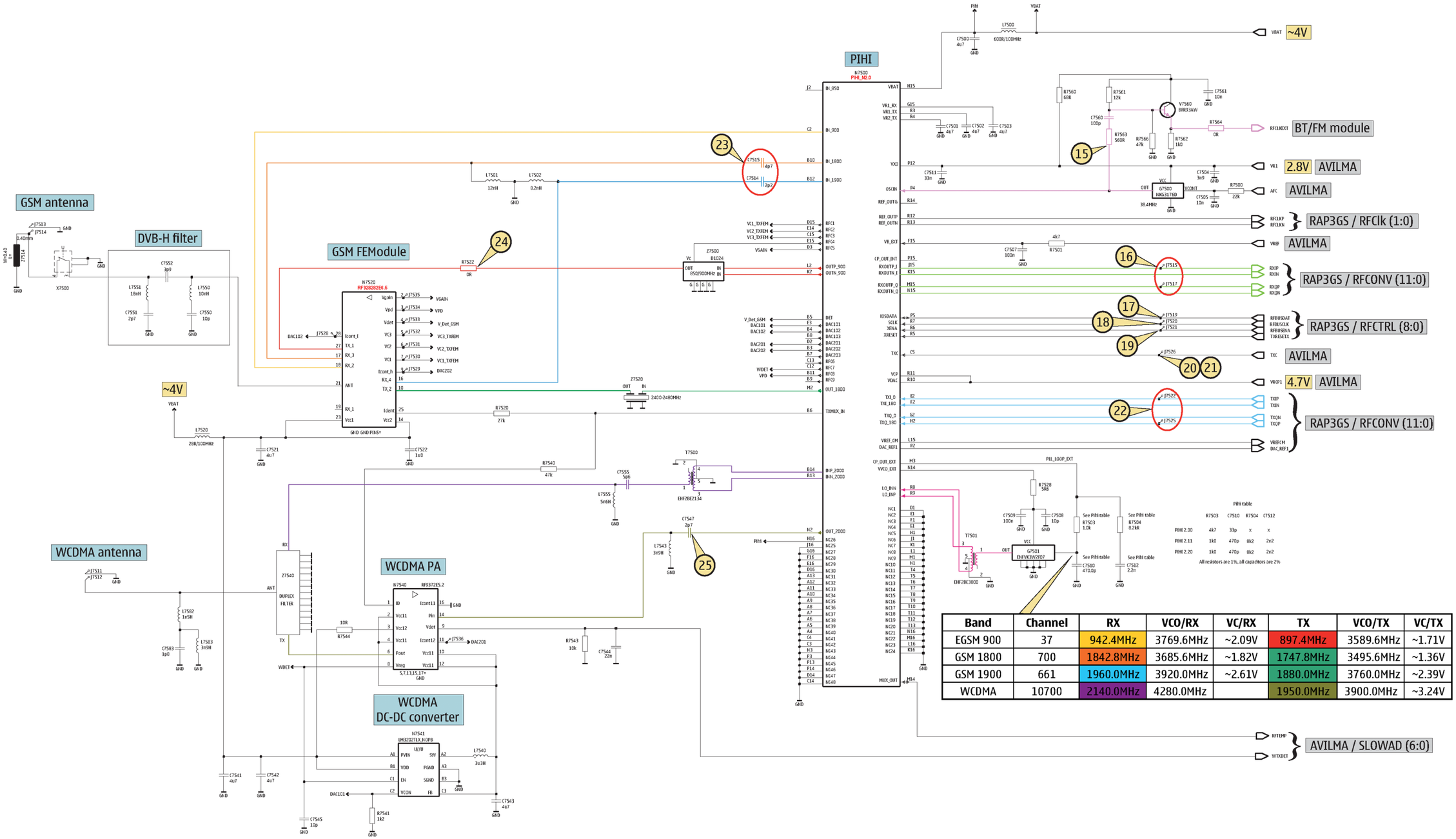
## RF part-changes to HWID 1500




| Band | Channel | RX | VCO/RX | VC/RX | TX | VCO/TX | VC/TX |
|---|---|---|---|---|---|---|---|
| EGSM 900 | 37 | 942.4MHz | 3769.6MHz | ~2.09V | 897.4MHz | 3589.6MHz | ~1.71V |
| GSM 1800 | 700 | 1842.8MHz | 3685.6MHz | ~1.82V | 1747.8MHz | 3495.6MHz | ~1.36V |
| GSM 1900 | 661 | 1960.0MHz | 3920.0MHz | ~2.61V | 1880.0MHz | 3760.0MHz | ~2.39V |
| WCDMA | 10700 | 2140.0MHz | 4280.0MHz | | 1950.0MHz | 3900.0MHz | ~3.24V |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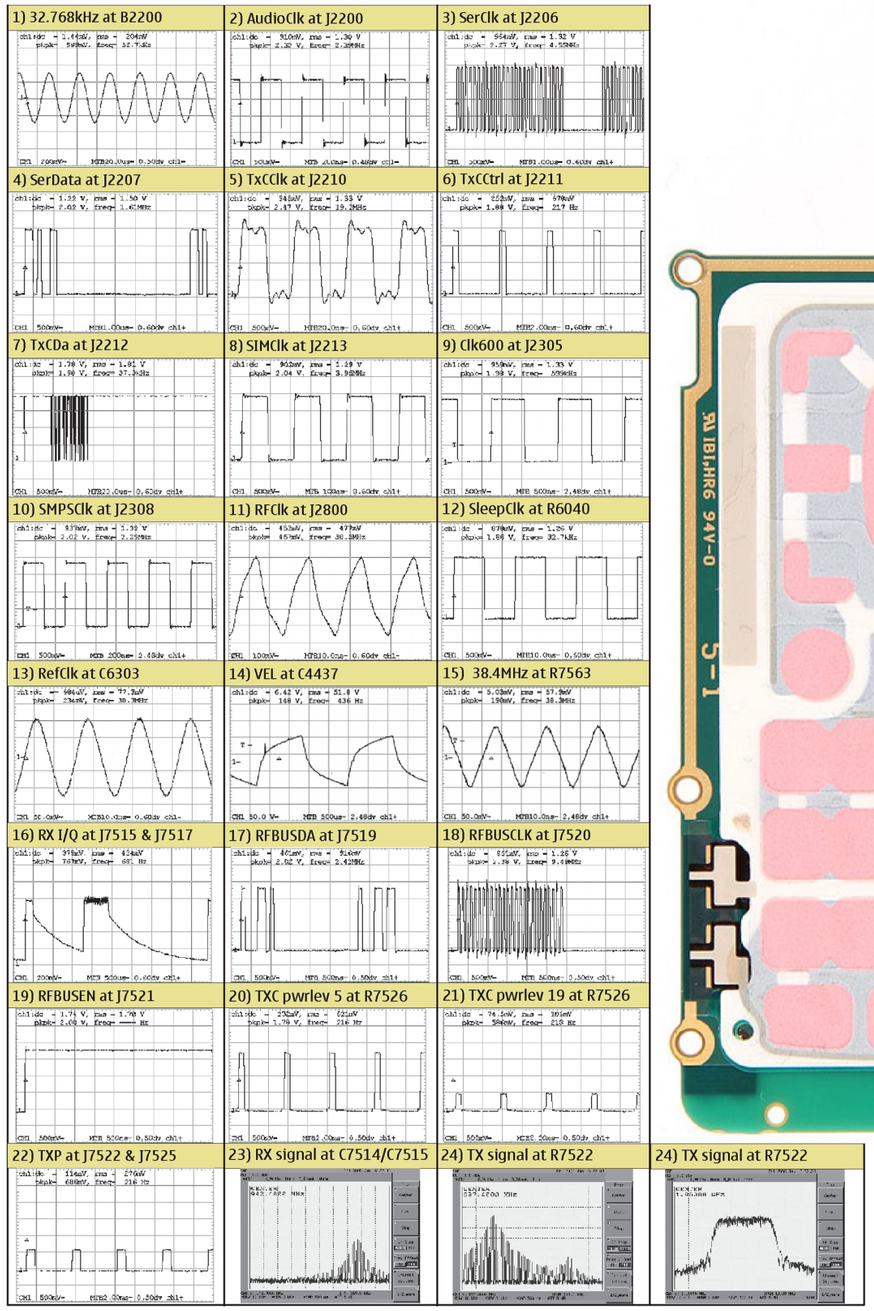
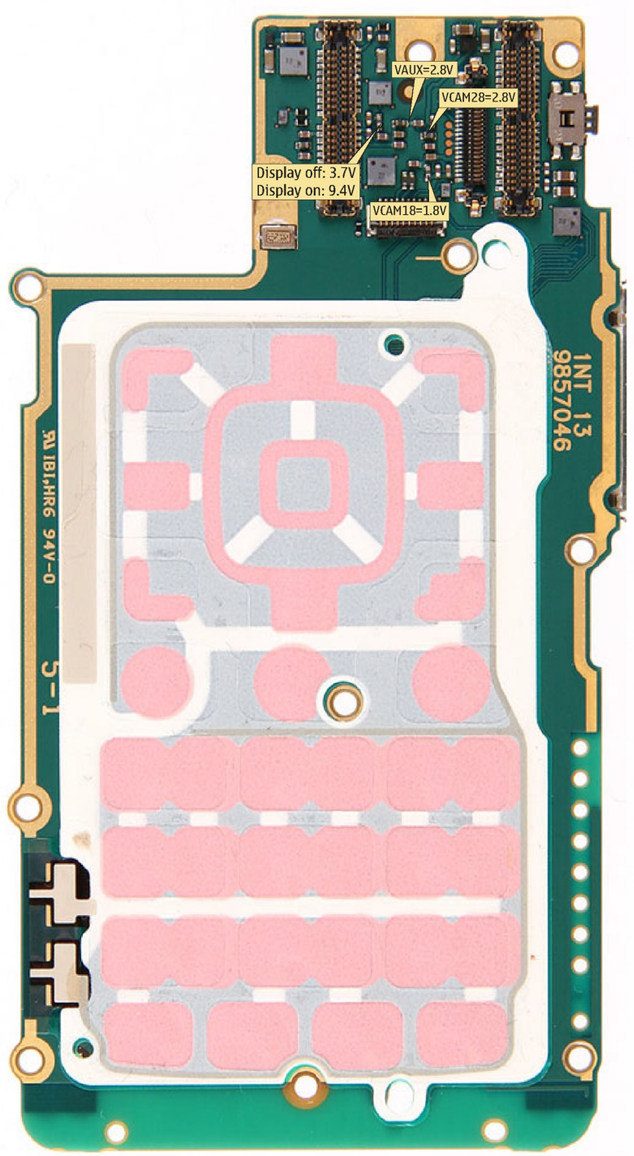
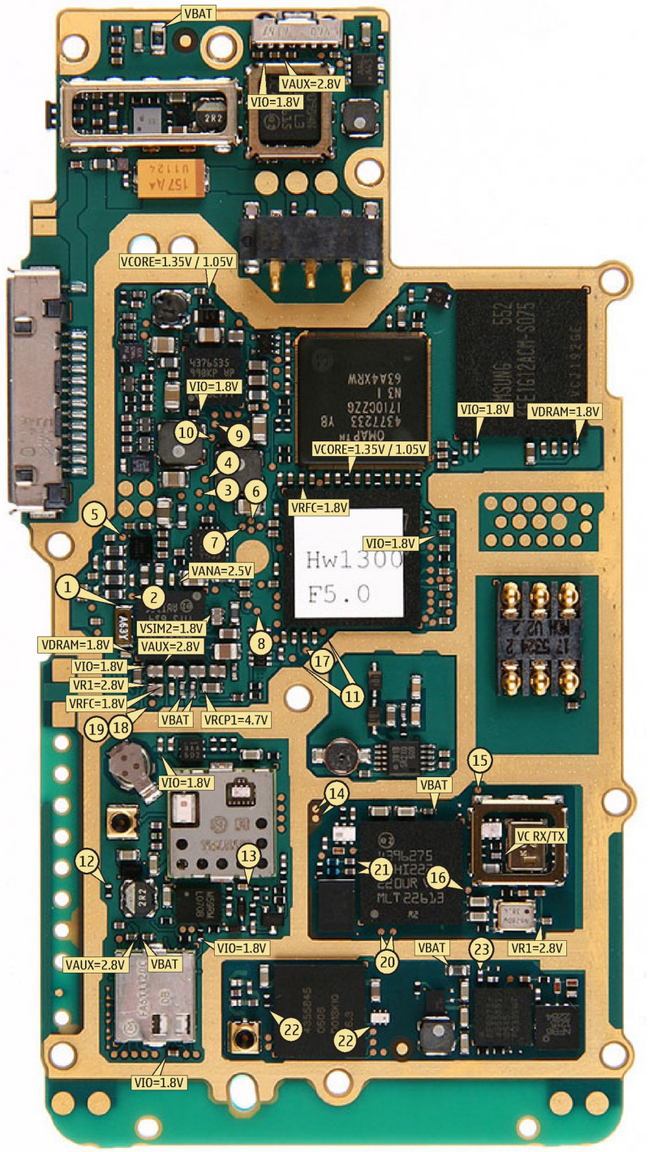
## Signal overview





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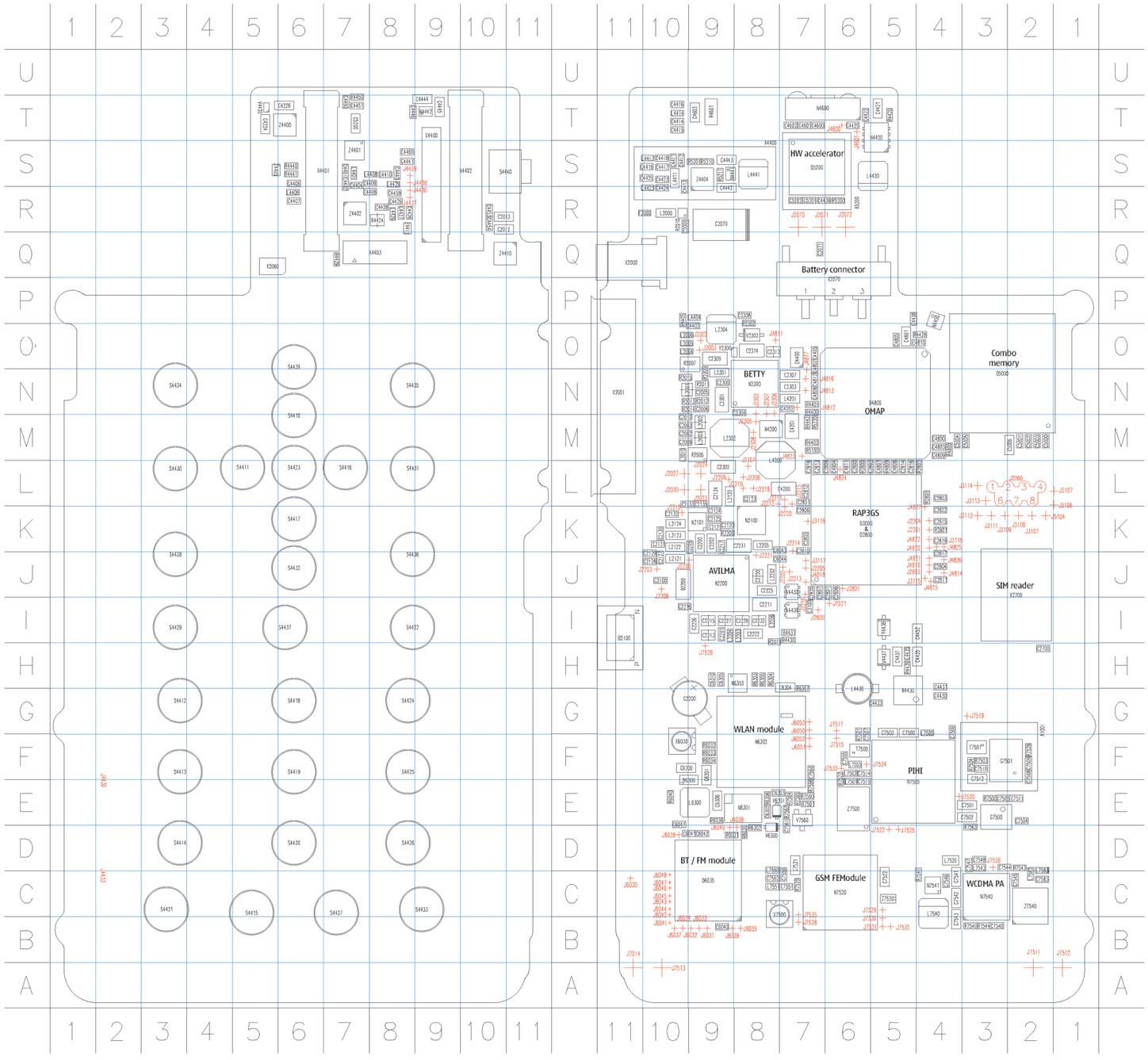
## Component finder

| B | | C2810 | K7 | C4460 | S8 | C7550 | C7 | L7555 | F6 | R6034 | F9 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| B2100 | I11 | C2811 | J4 | C4600 | T7 | C7551 | C7 | L7582 | C2 | R6036 | E9 |
| B2200 | J10 | C2812 | L7 | C4601 | T7 | C7552 | C8 | L7583 | D2 | R6040 | E10 |
| C | | C2813 | L7 | C4602 | T7 | C7555 | F6 | N | | R6302 | D8 |
| C2000 | R10 | C2814 | L5 | C4603 | T9 | C7560 | F7 | N2100 | K8 | R6303 | H8 |
| C2002 | M10 | C2815 | K4 | C4800 | M4 | C7561 | D7 | N2101 | K9 | R6304 | H8 |
| C2003 | M10 | C2816 | L5 | C4801 | O5 | C7583 | C2 | N2200 | J9 | R6305 | H8 |
| C2005 | N9 | C2817 | J4 | C4802 | O7 | D | | N2300 | N8 | R6306 | E8 |
| C2006 | N9 | C2818 | L7 | C4803 | M4 | D2800 | K6 | N4200 | M8 | R6307 | G7 |
| C2009 | M10 | C2819 | K4 | C4804 | L6 | D3000 | K6 | N4420 | T5 | R7500 | E3 |
| C2010 | M10 | C2820 | J7 | C4805 | O5 | D4400 | O7 | N4430 | G5 | R7501 | F6 |
| C2012 | R10 | C2821 | L7 | C4806 | N7 | D4800 | N5 | N4441 | S9 | R7503 | F3 |
| C2013 | R10 | C2822 | K4 | C4807 | L5 | D5000 | N3 | N4442 | T9 | R7504 | F3 |
| C2070 | R9 | C3100 | I7 | C4808 | L5 | D5200 | S7 | N4450 | P4 | R7520 | C7 |
| C2071 | Q7 | C4200 | L7 | C4809 | M4 | D6035 | C9 | N4600 | T7 | R7522 | F6 |
| C2100 | J10 | C4201 | M7 | C4810 | O4 | F | | N6300 | E9 | R7528 | F2 |
| C2120 | K9 | C4202 | N7 | C4811 | L6 | F2000 | R10 | N6301 | E8 | R7540 | B3 |
| C2121 | K9 | C4224 | T5 | C4812 | N7 | G | | N6302 | F8 | R7541 | C4 |
| C2123 | L8 | C4226 | T6 | C5000 | M2 | G2200 | G9 | N6303 | H8 | R7543 | D2 |
| C2124 | K9 | C4401 | S7 | C5001 | M2 | G7500 | E3 | N7500 | E5 | R7544 | B3 |
| C2125 | K9 | C4402 | S7 | C5002 | M2 | G7501 | F3 | N7520 | C6 | R7560 | E7 |
| C2127 | J10 | C4403 | O9 | C5003 | M2 | L | | N7540 | C3 | R7561 | E7 |
| C2128 | J10 | C4404 | S7 | C5004 | M4 | L2000 | R10 | N7541 | C4 | R7562 | E7 |
| C2129 | J10 | C4405 | O7 | C5005 | M3 | L2001 | N10 | R | | R7563 | D3 |
| C2130 | K10 | C4406 | S6 | C5006 | M2 | L2002 | M9 | R2006 | M9 | R7564 | E7 |
| C2131 | K10 | C4407 | R6 | C5200 | T7 | L2003 | M9 | R2007 | O9 | R7565 | E7 |
| C2132 | K10 | C4408 | R8 | C5201 | R7 | L2004 | O10 | R2009 | N9 | R7566 | E7 |
| C2133 | L10 | C4409 | S8 | C5202 | R7 | L2005 | O10 | R2010 | R10 | S | |
| C2134 | L9 | C4410 | S8 | C6040 | B9 | L2006 | O10 | R2011 | N9 | S4440 | S10 |
| C2135 | L9 | C4411 | S10 | C6041 | D9 | L2010 | M10 | R2012 | N9 | T | |
| C2200 | K9 | C4412 | S10 | C6042 | D9 | L2120 | L9 | R2013 | N9 | T7500 | F6 |
| C2201 | I9 | C4413 | R10 | C6043 | K7 | L2121 | J10 | R2014 | N9 | T7501 | F3 |
| C2202 | K9 | C4414 | T10 | C6044 | J7 | L2122 | K10 | R2015 | N10 | V | |
| C2205 | K9 | C4415 | T10 | C6047 | E10 | L2123 | K10 | R2071 | I8 | V2300 | O8 |
| C2211 | I8 | C4416 | T10 | C6300 | F10 | L2124 | K10 | R2200 | K9 | V2303 | O8 |
| C2213 | I9 | C4417 | S10 | C6301 | F9 | L2202 | J8 | R2302 | P8 | V4420 | T5 |
| C2215 | I9 | C4418 | S10 | C6302 | E8 | L2203 | I8 | R2800 | L6 | V4430 | J7 |
| C2216 | I10 | C4419 | S10 | C6303 | E8 | L2204 | I9 | R2801 | K4 | V4436 | I7 |
| C2217 | K9 | C4420 | T6 | C6304 | H7 | L2205 | K8 | R2802 | L4 | V4437 | H5 |
| C2220 | J8 | C4421 | T5 | C6305 | H9 | L2206 | I8 | R2803 | L4 | V4438 | I5 |
| C2222 | I8 | C4422 | T6 | C6306 | E9 | L2301 | N9 | R4400 | N7 | V6300 | D8 |
| C2225 | J8 | C4423 | S10 | C6310 | H9 | L2302 | M9 | R4401 | N7 | V6301 | E8 |
| C2226 | I9 | C4424 | R10 | C7500 | G5 | L2304 | O9 | R4403 | M7 | V7560 | E7 |
| C2227 | I9 | C4425 | S10 | C7501 | E3 | L4200 | M8 | R4405 | P10 | X | |
| C2228 | I8 | C4426 | R8 | C7502 | E3 | L4201 | N7 | R4420 | T5 | X2000 | Q11 |
| C2231 | K8 | C4427 | R8 | C7503 | G5 | L4401 | S7 | R4424 | R8 | X2001 | N11 |
| C2232 | I8 | C4428 | R8 | C7504 | E2 | L4404 | P9 | R4428 | O4 | X2060 | Q5 |
| C2300 | N9 | C4429 | R8 | C7505 | E3 | L4406 | R6 | R4429 | Q7 | X2070 | P6 |
| C2301 | N9 | C4430 | G4 | C7506 | G4 | L4408 | S8 | R4430 | I7 | X2700 | J2 |
| C2302 | L9 | C4431 | H4 | C7507 | F6 | L4411 | S10 | R4431 | I7 | X4400 | S9 |
| C2303 | N7 | C4433 | G5 | C7508 | F2 | L4414 | T10 | R4439 | H5 | X4401 | S6 |
| C2304 | N8 | C4435 | H4 | C7509 | F2 | L4417 | S10 | R4440 | S6 | X4402 | S10 |
| C2307 | N7 | C4437 | H5 | C7510 | F3 | L4420 | S5 | R4441 | S6 | X4403 | Q8 |
| C2308 | P8 | C4438 | P5 | C7511 | E2 | L4423 | R10 | R4442 | M7 | X6030 | F10 |
| C2309 | O9 | C4439 | R7 | C7512 | F3 | L4426 | R8 | R4450 | T7 | X7500 | C8 |
| C2312 | O8 | C4440 | S8 | C7514 | F6 | L4429 | S8 | R4601 | T9 | Z | |
| C2314 | O8 | C4441 | S8 | C7515 | E6 | L4430 | G6 | R4800 | M4 | Z4400 | T6 |
| C2700 | H2 | C4442 | R9 | C7521 | D7 | L4435 | H5 | R4809 | L5 | Z4401 | S7 |
| C2800 | L6 | C4443 | S9 | C7522 | C5 | L4441 | S8 | R5100 | M7 | Z4402 | R7 |
| C2801 | J6 | C4444 | T9 | C7540 | B3 | L6300 | E9 | R5200 | R6 | Z4404 | S9 |
| C2802 | L6 | C4445 | T9 | C7541 | C4 | L7500 | G4 | R5201 | S9 | Z4405 | S5 |
| C2803 | L4 | C4446 | T8 | C7542 | C4 | L7501 | E6 | R5210 | S9 | Z4410 | Q10 |
| C2804 | J4 | C4450 | T7 | C7543 | B4 | L7502 | F6 | R5211 | S9 | Z4411 | R8 |
| C2805 | K7 | C4451 | T7 | C7544 | D3 | L7520 | D4 | R5220 | M7 | Z7500 | E6 |
| C2806 | K7 | C4452 | I4 | C7545 | C2 | L7540 | C4 | R6030 | D8 | Z7520 | C5 |
| C2807 | J7 | C4453 | R10 | C7546 | C4 | L7543 | D3 | R6031 | D9 | Z7540 | C2 |
| C2808 | J6 | C4454 | R10 | C7547 | D3 | L7550 | D8 | R6032 | F9 | | |
| C2809 | L6 | C4459 | R8 | C7548 | D3 | L7551 | C8 | R6033 | F9 | | |





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# Glossary


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| | |
|---|---|
| A/D-converter | Analog-to-digital converter |
| ACI | Accessory Control Interface |
| ADC | Analog-to-digital converter |
| ADSP | Application DPS (expected to run high level tasks) |
| AGC | Automatic gain control (maintains volume) |
| ALS | Ambient light sensor |
| AMSL | After Market Service Leader |
| ARM | Advanced RISC Machines |
| ARPU | Average revenue per user (per month or per year) |
| ASIC | Application Specific Integrated Circuit |
| ASIP | Application Specific Interface Protector |
| B2B | Board to board, connector between PWB and UI board |
| BB | Baseband |
| BC02 | Bluetooth module made by CSR |
| BIQUAD | Bi-quadratic ,type of filter function) |
| BSI | Battery Size Indicator |
| BT | Bluetooth |
| CBus | MCU controlled serial bus connected to UPP_WD2,UEME and Zocus |
| CCP | Compact Camera Port |
| CDSP | Cellular DSP (expected to run at low levels) |
| CLDC | Connected limited device configuration |
| CMOS | Complimentary metal-oxide semiconductor circuit (low power consumption) |
| COF | Chip on Foil |
| COG | Chip on Glass |
| CPU | Central Processing Unit |
| CSR | cambridge silicon radio |
| CSTN | Color Super Twisted Nematic |
| CTSI | Clock Timing Sleep and interrupt block of Tiku |
| CW | Continuous wave |
| D/A-converter | Digital-to-analouge converter |
| DAC | Digital-to-analouge converter |
| DBI | Digital Battery Interface |
| DBus | DSP controlled serial bus connected between UPP_WD2 and Helgo |
| DCT-4 | Digital Core Technology |
| DMA | Direct memory access |
| DP | Data Package |


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| | |
|---|---|
| DPLL | Digital Phase Locked Loop |
| DSP | Digital Signal Processor |
| DtoS | Differential to Single ended |
| EDGE | Enhanced data rates for global/GSM evaluation |
| EGSM | Extended GSM |
| EM | Energy management |
| EMC | Electromagnetic compability |
| EMI | Electromagnetic interference |
| ESD | Electrostatic discharge |
| FCI | Functional cover interface |
| FPS | Flash Programming Tool |
| FR | Full rate |
| FSTN | Film compensated super twisted nematic |
| GND | Ground, conductive mass |
| GPIB | General-purpose interface bus |
| GPRS | General Packet Radio Service |
| GSM | Group Special Mobile/Global System for Mobile communication |
| HF | Hands free |
| HFCM | Handsfree Common |
| HS | Handset |
| HSCSD | High speed circuit switched data (data transmission connection faster than GSM) |
| HW | Hardware |
| I/O | Input/Output |
| IBAT | Battery current |
| IC | Integrated circuit |
| ICHAR | Charger current |
| IF | Interface |
| IHF | Integrated hands free |
| IMEI | International Mobile Equipment Identity |
| IR | Infrared |
| IrDA | Infrared Data Associasion |
| ISA | Intelligent software architecture |
| JPEG/JPG | Joint Photographic Experts Group |
| LCD | Liquid Crystal Display |
| LDO | Low Drop Out |
| LED | Light-emitting diode |


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| | |
|---|---|
| LPRF | Low Power Radio Frequency |
| MCU | Micro Controller Unit (microprocessor) |
| MCU | Multiport control unit |
| MIC, mic | Microphone |
| MIDP | Mobile Information Device Profile |
| MIN | Mobile identification number |
| MIPS | Million instructions per second |
| MMC | Multimedia card |
| MMS | Multimedia messaging service |
| NTC | Negative temperature coefficient, temperature sensitive resistor used as a temperature sensor |
| OMA | Object management architechture |
| OMAP | Operations, maintenance, and administartion part |
| Opamp | Operational Amplifier |
| PA | Power amplifier |
| PDA | Pocket Data Application |
| PDA | Personal digital assistant |
| PDRAM | Program/Data RAM (on chip in Tiku) |
| Phoenix | Software tool of DCT4.x |
| PIM | Personal Information Management |
| PLL | Phase locked loop |
| PM | (Phone) Permanent memory |
| PUP | General Purpose IO (PIO), USARTS and Pulse Width Modulators |
| PURX | Power-up reset |
| PWB | Printed Wiring Board |
| PWM | Pulse width modulation |
| RC-filter | Resistance-Capacitance filter |
| RF | Radio Frequency |
| RF PopPort TM | Reduced function PopPortTM interface |
| RFBUS | Serial control Bus For RF |
| RSK | Right Soft Key |
| RS-MMC | Reduced size Multi Media Card |
| RSSI | Receiving signal strength indicator |
| RST | Reset Switch |
| RTC | Real Time Clock (provides date and time) |
| RX | Radio Receiver |


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| | |
|---|---|
| SARAM | Single Access RAM |
| SAW filter | Surface Acoustic Wave filter |
| SDRAM | Synchronous Dynamic Random Access Memory |
| SID | Security ID |
| SIM | Subscriber Identity Module |
| SMPS | Switched Mode Power Supply |
| SNR | Signal-to-noice ratio |
| SPR | Standard Product requirements |
| SRAM | Static random access memory |
| STI | Serial Trace Interface |
| SW | Software |
| SWIM | Subscriber/Wallet Identification Module |
| TCXO | Temperature controlled Oscillator |
| Tiku | Finnish for Chip, Successor of the UPP, Official Tiku3G |
| TX | Radio Transmitter |
| UART | Universal asynchronous receiver/transmitter |
| UEME | Universal Energy Management chip (Enhanced version) |
| UEMEK | See UEME |
| UI | User Interface |
| UPP | Universal Phone Processor |
| UPP_WD2 | Communicator version of DCT4 system ASIC |
| USB | Universal Serial Bus |
| VBAT | Battery voltage |
| VCHAR | Charger voltage |
| VCO | Voltage controlled oscillator |
| VCTCXO | Voltage Controlled Temperature Compensated Crystal Oscillator |
| VCXO | Voltage Controlled Crystal Oscillator |
| Vp-p | Peak-to-peak voltage |
| VSIM | SIM voltage |
| WAP | Wireless application protocol |
| WD | Watchdog |
| XHTML | Extensible hypertext markup language |
| Zocus | Current sensor, (used to monitor the current flow to and from the battery) |


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